Contents—July 1947

Volume XXVIII No. 7

ARCHIVES OF PHYSICAL MEDICINE
(Formerly Archives of Physical Therapy)
30 North Michigan Avenue, Chicago 2, Illinois

Published monthly at Chicago, Illinois, by American Congress of Physical Medicine.

Entered as Second Class Matter, February 15, 1945, at the Post Office at Chicago, Illinois, under the Act of March 3, 1879.

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THE INFLUENCE OF MUSCLE ACTION ON TISSUE REPAIR *

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When I accepted the much appreciated invitation of this Congress of Physical Medicine to be with you today I realized with a certain amount of trepidation that by my acceptance I committed myself to the reading of a paper to a congregation of experts in the many and varied branches of physical medicine, whose writings I have read with great pleasure, admiration and instruction throughout the years.

As I have never considered myself to be an expert in physical medicine in the true sense of the term — my professional work having been in the realm of orthopedics — I could not approach the matter without a certain amount of anxiety with regard to my qualifications to give an address before a body so representative as that of the American Congress of Physical Medicine. I must admit that I found it no light task to decide on a suitable subject. However, as I have spent a long professional life in the study and treatment of muscle and joint injuries, and as my methods in this field have been based on an early realization of the importance of maintaining the physiologic activity of muscles at its maximum in relation to the treatment of inflamed joint tissues and particularly during the early stages, I felt that I could do no better than try to give you my views on this intensely interesting but somewhat complicated subject.

I began the study of muscle action when I was a student, over forty-five years ago. My experience over such a length of time, therefore, leads me to say that in our effort to aid Nature to accomplish repair during and after inflammation of joint structures this important feature has not received the general attention it deserves, particularly in cases of strained muscles and sprained joints, which make up such a strikingly large percentage of the crippled joints seen in everyday practice. I do not deny that the importance of the restoration of muscle function after muscle injury is now much more fully realized than it was formerly, but until quite recently the muscle condition, considering the attention paid to every other component part of a joint, has been relatively neglected. In the effort to restore a joint to normal after injury, it is necessary to aim at the repair of every structure concerned in the mechanism of the joint under treatment.

It is a common experience to find that a joint may reach a state of complete repair of all its components but, because the muscles operating the joint have been neglected and so remain atonic and slightly wasted, that joint is more or less crippled so far as its effective function is concerned, for reasons which I shall presently explain. I feel sure that all of you have seen joints in this condition of imperfect muscular repair in the last stages after injury; you may indeed have felt at a loss to know what to advise beyond voluntary exercise, which, by itself, is not by any means the panacea for the restoration of muscle function it is so commonly reputed to be. I

* Read at the Twenty-Fourth Annual Session of the American Congress of Physical Medicine, New York, Sept. 4, 1946.

contend that muscles, although their nerve path is complete, may be in such a condition of posttraumatic atonicity and atrophy (even after what may be described as minor injuries) that no amount of exercise alone will fully restore them to their pristine functional activity. Such muscles, however, if they have their tone first restored by the correct technic of eletrical stimulation, will show growth of muscle fibers at a far greater rate and of far greater efficiency than would be possible by exercises alone. At the right moment, voluntary exercise will play its part in increasing the muscle bulk.

To elaborate my thesis, it is necessary briefly to point out some of the main changes which may take place in muscles and certain other joint structures after injury and the significance of such changes. Injured joint structures cannot be intelligently treated without a knowledge of the normal physiology of articular tissue and of the normal chemistry and cytology of synovial fluid, and it must be emphasized that great changes may take place in these structures which materially delay recovery if treatment is not applied early in even simple injuries. The watch words must therefore always be "Early treatment particularly designed to restore the tone of muscles."

In any inflamed joint, whether the inflammatory changes are considered those due to repair after a strain or sprain or those due to postoperative changes or those due to the more serious inflammation of disease, there is always a history of early loss of tone of the muscles followed equally rapidly by wasting of the muscle fibers. It is during this early stage that well designed electrical stimulation applied to the muscles is the most potent aid to their natural repair and to the repair of all the other damaged tissues. This is the fact I wish to emphasize strongly.

Even if, as in the first stages after injury, little obvious wasting is present, the loss of tone alone which quickly supervenes is sufficient to upset the balance of muscular activity. This reacts on the function of a joint, because the atonic muscles become incapable of full and rapid contraction, the result being that the action of the joint is limited and the nutrition of other structures is interfered with on account of the diminution of circulation caused by loss of the pumping action of fully active muscle. Healthy muscle is capable of protecting a joint by intercepting almost instantaneously any sudden stress which might damage its structures. This rapid protective action is due to the muscle tone and to the power, inherent in muscle, to contract in response to a variety of stimuli.

Good muscular tone and power to contract fully and rapidly are essential to the security of a joint, and it may be said that no damaged joint can be considered to have recovered completely until the tone and contractility of its musculature have been restored to normal.

The importance of good muscle tone cannot be exaggerated. Muscle is a highly sensitive organ built up of various structures but possessing a particular structure — namely, that formed by the special cells which possess the power of developing a state of tension. It is on this state of tension, which can be tranlated into work, that movements of the different parts of the body are made possible. Muscle tone may be described as a "muscle's state of attention by virtue of which it is able to respond immediately to a physiological stimulus," and the degree of tone of a muscle is dependent upon the physiologic properties of elasticity, contractility and irritability which are peculiar to muscle.

A muscle is able to respond readily to a stimulus by virtue of its irritability; it is capable of shortening on the application of a stimulus owing to its contractility, and as the result of its elasticity it returns to its original shape after the removal of a deforming force. The elastic fibers in the con-

nective tissue which exists between muscle fibers play an essential part in permitting a muscle to return to its original shape. Muscles are never atonic in health. When movement takes place delicate adjustments of tension occur, and when the person is resting the tension in the muscle cells is equal, postural tone being maintained by contraction of a few fibers in each muscle. It may be said, therefore, that a muscle is in a good state of tone when its irritability, contractility and elasticity are normal.

All the tissues of the body are dependent, for their nourishment and for the equally important clearance of the waste products of metabolism, on keeping the arterial venous and lymphatic circulations in a high state of efficiency. The part that movement — that is, muscle action — plays in the efficiency of the circulatory systems is of such paramount importance that serious interference with both local and general metabolism may follow the loss or diminution of muscular action from any cause. In order that this may be fully realized, a few of the main facts about circulation in muscle may now be enumerated.

The blood supply to a muscle in action has been computed by physiologists to be at least eight times that required by a muscle at rest. The capillaries lie in loops running between and parallel to the muscle fibers and during rest may lie closed entirely; as activity increases more and more, the capillaries open. Krogh has calculated that in a strip of muscle the thickness of a pin there are 200 muscle fibers and over 700 capillaries; from these figures it will be seen how rich in blood muscles are.

By their contraction and relaxation, muscles act as powerful pumping machines and thereby contribute to the free passage of the blood through the muscle capillaries to all the various structures in the neighborhood; at the same time the stimulus of muscle activity brings to the acting muscles themselves just exactly the amount of blood necessary to enable them to carry out the special activity of the moment. The onward movement of the lymph stream in the tissue spaces is also powerfully encouraged, and, as synovial membrane, ligaments and muscles are abundantly supplied with lymphatics, such movement of the lymph stream is obviously of supreme importance. This is particularly so in the synovial membrane of a joint because of the action of this membrane in draining fluids from the joints, in supplying nourishment to the articular cartilage and in acting as a scavenger for removing the debris of wear and tear. Sluggish draining of lymph from periarticular tissue spaces is an impediment to free and painless joint movements.

As muscular contraction follows relaxation, the system of valves present in the veins ensures that in every muscle there is an effective pump capable of maintaining the required low pressure in the muscle capillaries. Muscle relaxation is also a powerful aid to circulation, since by its action it opens up the lumina of vessels and the capillaries become filled again from their peripheral ends only. It should be remembered that relaxation is as important a physiologic property of muscle as is contraction, but it is not certain whether or not relaxation is merely passive and due to the absence of a stimulus-exciting contraction. When a muscle group contracts, the fact that the antagonist group relaxes suggests that there is a positive stimulus to relaxation. There is also the possibility that one nerve fiber may be capable of initiating contraction at one moment and relaxation at another.

According to the requirements of muscles when they are called into action or when they are lying at rest, the exact amount of blood is brought to them and drained from them. All the units of the vascular system are perfectly adapted to the ever-changing conditions in muscles as the result

of contraction and relaxation of various degrees; in normal muscles the system is under perfect control. It has been suggested that chemical products resulting from metabolic activity resulting from muscle activity may also cause dilation of blood vessels by direct local stimulation.

During life there are three active streams taking place in the tissues: the stream from the blood to the tissues, the stream from the tissues to the blood and the important lymph stream from the tissue lymph spaces to the lymph vessels. By circulation of the blood, nourishment and oxygen are supplied to every tissue cell of the body, waste products which are the result of tissue activity are removed and various chemical substances are carried from one part of the organism to another. To enable the blood to carry out these vital functions efficiently, free circulation is essential; and with this picture of blood circulation in muscle before you I would stress the very important part that muscle contraction and relaxation play in aiding the onward movement of the blood and lymph stream through the tissues. When it is also recalled that approximately 40 per cent of the body weight is due to skeletal muscle, it will be readily seen why loss or limitation of muscle activity may have far-reaching effects on the general nourishment and activity of the various body tissues. When normal circulation is diminished, the tissues undergo certain alterations accompanied with various degrees of functional disturbance.

The effects of inflammation are intended to be beneficial, but this can be so only when the processes of inflammation and repair come to a successful end in a reasonable time. Harmful effects of prolonged inflammation so often produced after injury are chiefly the direct outcome of the penetration into the tissues of increased fluid and solid constituents of the blood, which act on various tissue elements mechanically, physiologically and pathologically.

The most important harmful effects of prolonged interference with circulation from delayed repair are pressure effects due to hyperemia. Pressure effects cause excessive intercellular tension; slowing up or even arrest of the intracellular movements within individual cells and of subsidiary movements between tissue planes; pressure on and undue stretching of tissues, particularly nerve endings; further slowing of the local circulation, particularly in inextensible tissues such as ligaments, aponeuroses and tendons; local anemia and death of certain cells. All such pressure effects contribute to the sensation of pain.

Hyperemia causes redness, heat and swelling; incomplete removal of substances resulting from tissue metabolism; dilatation of veins beyond their valve efficiency point, and, ultimately, sluggish and incomplete muscular contraction and relaxation. Transudation of fluids and solids from the blood stream beyond the normal occurs, owing to the increased pressure in the capillaries and veins over the surrounding cellular pressure, and finally a permanent enlargement of small vessels may lead to hypertrophy of histologic elements. The incomplete removal of waste products of metabolism may even choke the small vessels, and this, with the dilatation of the veins beyond their valve efficiency point and the loss of the onward push of the venous circulation from incomplete musculat action, tends further to increase the local hyperemia. A vicious circle is therefore set up, which seriously retards repair.

What are the main consequences of atonicity and atrophy in a muscle in which the nerve supply is intact? Almost immediately after injury to a joint, muscles become atonic; and if they do not recover quickly, atrophy of varying degree quickly supervenes. The importance of this cannot be ex-

aggerated because of the far-reaching effects on circulation already described and on the functional efficiency of muscles themselves, a study of which will show the reason that treatment designed to restore tone and to prevent atrophy after injury is based on sound physiology and should be carried out as early as possible.

To encourage repair of damaged tissues, prevention of blood and lymph stagnation is essential, and this may be achieved by treatment designed to produce muscular contractions and relaxations. Muscle function, therefore, naturally or electrically produced, acts as a powerful stimulus in preventing stagnation of fluids when tissue irritation stirs into activity the energy for repair inherent in the body cells.

1. When a muscle becomes hypotonic it has lost its irritability, elasticity and contractility; in this condition muscle fibers quickly waste, with corresponding loss of function to all degrees. The muscle at first becomes relaxed and its tendons of origin and insertion are at an operating disadvantage mechanically so far as the pull on the points of attachment of the muscle are concerned, thus adding to the ineffectiveness of the already weakened muscle. A further effect is the loss of the normal pull of atonic and wasted muscles on opposing muscles, which encourages the latter to become contracted; this contraction may reach such a degree that it seriously interferes with the recovery of their agonists. The ligaments and capsules become stretched and loose in their texture, and this is highly important because ligaments must be supported by muscular activity. Their structure of white fibrous tissue proves that they can never withstand continuous strain without stretching. Afferent impulses from the ligaments of a joint set up the required reflex muscular action under normal conditions so that the ligament is protected from a stretching strain.

2. In atonic and wasted muscles the myotatic, or stretch, reflex is affected. The reflex acts in the following way: When the muscles of a limb are suddenly stretched, the myotatic reflex causes an almost instantaneous involuntary contraction, the degree of contraction depending on the strength of the stretching stimulus. The contraction lasts just long enough and is of sufficient strength to support the limb until a postural or voluntary contraction takes place. When stresses are suddenly applied to muscles during body movements and particularly in the involuntary movements that overcome gravity, this reflex is of extreme importance in protecting structures from damage, as its essential quality is rapidity of action; damage to joint structures from sudden movements often results when the protecting muscles are atonic or wasted and when the reflex in consequence loses its essential quality of speed. In a wasted quadriceps muscle, the knee often gives way because the sluggish action of the myotatic reflex prevents the instantaneous contraction necessary to steady the joint until a postural or voluntary contraction has time to take place.

3. On account of the inability of atonic and wasted muscles to work effectively with synergic muscles, the balance of precise movements is upset. This is a complicated action, necessitating muscles that be in a state of high efficiency — that is to say, in good tone. It operates in the following way. When parts of the body, as the result of muscle tension being translated into work, are moved relatively to each other one is apt to forget that such movements are not achieved only by contraction and relaxation of the particular group of muscles responsible for the movement. Other muscles fix the parts to enable the particular movement to be carried out to the best advantage. These auxiliary muscles are the synergist muscles. For example, when the fist is closed, the optimum position which permits the flex-

ors of the fingers to exert their greatest strength is the position of dorsiflexion of the wrist. The wrist extensors hold the wrist firmly in dorsiflexion and thus act as the synergists of the finger flexors; if the clenching of the fist is increased in strength beyond a certain point, the triceps as a synergist fixes the elbow joint and thus gives greater power still to the finger flexors. Atonic and wasted muscles thus interfere with the efficient action of synergist muscles.

4. When the muscles concerned are atonic and wasted, the perfect balance of certain movements is upset under conditions in which the muscles of a group are normally associated in carrying out certain voluntary movements. As an example, one may take the case of the right leg being abducted at the hip in the erect position; here the left tensor fasciae femoris muscle immediately contracts; similarly, if the mouth is opened with the lower jaw fixed, the extensors of the head are brought into action and the head is thrown backward.

5. Atonic and wasted muscles upset the movement of cooperation. To understand this it must be realized that many principal muscle movements are always preceded by or accompanied with certain other movements which allow the main movement to be carried out effectively. As an example, when the human being rises from a chair, before the principal movement of standing up takes place, the feet must be drawn under the center of gravity of the body; hence this "movement of cooperation," as it is called, facilitates the action of muscles producing the essential but highly complicated movement of arising from the sitting position.

6. As the result of atony and wasting of muscles, the perfect balance of muscular contraction and relaxation is seriously affected. This perfect balance of muscular contraction and relaxation is a remarkable phenomenon, and in the study of the anatomy of movement it cannot be overstressed. Whenever a group of muscles contracts, it pulls against the opposing muscles, and these opposing muscles give way so gradually and their reciprocal inhibition is so perfectly controlled that they are able to offer the exact amount of resistance to the contracting muscles, with the result that balanced, nonjerky action is assured even when the contracting muscles act slowly, rapidly, suddenly, powerfully or gently. This perfect balance of muscular action involving contraction to the right degree and relaxation to the right degree can be seriously upset even if one muscle or group of muscles is unable to play its part with absolute control with regard to contraction, relaxation and perfect timing. When muscles act to produce movements in addition to the physiologic act of relaxation of antagonists to the pull of angonists, the antagonists have the power further to lengthen beyond their point of full relaxation if for the accomplishment of the necessary movement the agonists have to contract so strongly that they will exert a stretching force after the antagonists have reached their full point of physiologic relaxation. This extra elongation of the relaxed antagonists is mechanical, and when the strain of the contraction is released the muscle immediately returns to its normal relaxed length by virtue of its property of elasticity in its connective tissue due to the elastic fibers so abundantly present. This capacity of muscle to return to its original length on the removal of a deforming force is a considerable aid in the production of smooth, well balanced, nonjerky actions.

7. Coordinated movements depend upon "muscle sense." When muscles are atonic and wasted, muscle sense is interfered with. Such loss of muscle sense results in the slowing of muscle action in response to a stimulus and upsets the power of muscles to carry out coordinated movements

perfectly; this is well exemplified by the constant occurrence of synovitis of the knee joint when the quadriceps femoris muscle is wasted. The frequent recurrence of mild trauma to the synovial membrane, as a result of stresses applied to the knee joint which are not countered efficiently because the wasted muscles are not quick enough in their action to present it, cause synovial irritation and effusion of fluid.

8. Joints acted upon by muscles which are atonic or wasted are at a great operating disadvantage, and in time this may have serious damaging effect on the joint cartilage. When the transmission of stress forces through a joint remains normal, the form and structure of the joint remain normal. But alteration in the transmission of such forces is followed by changes in the joint structure. Thus the alteration of lines of force through a joint as the result of limited or improper use of a muscle or a group of muscles over a long time causes undue pressure on parts of the opposing surfaces of the articular cartilage, leading to serious and often permanent cartilaginous damage. It should be remembered that whenever one part moves on another by the mechanism of a joint between bone ends this is by no means the only joint in operation. There are countless subsidiary joints lying between the muscles operating the main joint and the adjacent structures, such as ligaments, and these subsidiary joints between structures often have a joint cavity in the shape of a bursal sac. In addition, there are innumerable joints of vast importance to movement among other structures, such as the fascial planes, and between the tissues underlying the skin. To obtain mass movements of interosseous joints in a smooth coordinate manner, there must be involuntary movements beyond count at microscopic joints between individual fibers, with the tissue space acting as joint cavities. All such joints play their prescribed part in the movement of the main joint, enabling all the structures to move freely and painlessly on one another; all are subject, as the result of injury or disease, to interference with their pliability, this impeding joint action.

With these points in mind, it should be noted that before a voluntary movement — of which few persons realize the complexity — can be effectively carried out, there must be a knowledge of the objective in view. Think for a moment of the complexity: the chief muscles involved in carrying out efficiently such movements require to be assisted by well controlled antagonists, synergists to fix certain parts, other groups of muscles whose action is to precede or accompany the chief movements. Throughout all this, moreover, the individual muscle fibers (and it must be remembered that each muscle fiber with its nerve and blood supply constitutes a complete and separate unit) must contract and relax in the correct time and with the exact degree of strength required to give an efficient combined result, no matter how intricate or delicate the movements may be. It is a truly remarkable picture.

By considering what the muscles of the leg alone have to do during the act of walking, it can be well understood how atonic or wasted muscles throw out of gear the poise, balance and easy progression of the body, because they are unable to act synchronously with all the others taking part in the principal movement. During the act of propulsion of the body weight in walking, every one of the fifty-four muscles of the moving limb is brought into action, and with such exactitude that the muscles contract at the right moment and at the correct rate and strength to give a perfectly smooth and balanced action. During the time taken by the moving limb in completing a step, all the muscles of the other limb are contracting and relaxing in degree and time just as skilfully as those of the moving limb, so that perfect

balance is maintained and all deviations of the body weight from its center of gravity call counterbalancing muscles into immediate and accurate action. Thus, during the complicated muscle action of walking, each one of 108 muscles in the legs alone plays an individual part in producing such a perfect action.

In walking at the rate of four miles per hour, only half a second elapses from the time the heel is raised until the limb has swung forward and the foot again planted firmly on the ground. During this half second fifty-four muscles in one leg alone contract, relax, speed up and slow down a countless number of times, resulting in a perfectly controlled and well poised body propulsion. This, however, can take place only so long as all the participating muscles are in a state of the highest tone.

With such a picture of mechanical efficiency in mind, the seriousness of any interference with this beautiful combined action caused by a muscle or group of muscles being partially or wholly out of action and the urgency for early treatment of damaged muscles will be readily appreciated.

I must now briefly consider two points which must be constantly kept in mind when the treatment of injured muscles and other joint structures by intensive muscle stimulation is considered: (1) the all-important and often neglected areolar tissue; (2) the formation of adhesions.

In general characteristic, areolar tissue is a somewhat soft structure possessing great tenacity, elasticity and suppleness and, when normal, containing a small quantity of a translucent, lymph-like fluid sufficient to keep it moist and supple. It is lavishly distributed throughout the body, and, owing to the intercommunication of the areolar spaces, effusion into it is capable of traveling a considerable distance from one area into another. It acts as an agent for attaching various structures to one another, and it forms a supporting bed between the muscles and all other deep-seated structures; in so doing it fills up all the crevices and spaces. It acts as an investing sheath and as padding between organs, muscle groups and muscle fibers and as a supporting framework for blood vessels, lymphatics and nerves. When designed for free and easy movements, areolar tissue is arranged loosely, and where firm binding of parts is necessary it is more densely arranged. The moistness and suppleness of areolar tissue is of supreme importance as an aid to free and easy movements of parts, and I suggest that the characteristic creaking which takes place on movements of joints under certain conditions is due to the absence or diminution of this lymphlike lubricant of areolar tissue. An important factor in causing that bugbear of the orthopedic surgeon and the general practitioner alike, prolonged stiffness of joints and aching after even minor everyday injuries, is, I believe, the malnutrition and loss of flexibility and suppleness of the areolar tissue.

In cases of subacute inflammation so common after strains and sprains, the joint, particularly in the case of the ankle, is stiff after it has been at rest for some time. I suggest that this is due to the inflammatory changes causing loss of flexibility and suppleness of the areolar tissue. This is supported by the fact that such stiffness passes off soon after initial voluntary movements have occurred and also immediately after graduated muscular contractions have been electrically produced. It is conceivable that this phenomenon is due to the restoration for the time being, by such movements of the flexibility and suppleness, the muscular contractions removing accumulated edema. The condition is due entirely to delayed or final imperfect repair, and the fact that it is one of the most prolific causes of persistent discomfort and dysfunction of muscles and joints cannot be overstressed. The limitation of movements of muscles, tendons and other joint structures

and the subacute inflammatory changes taking place constitute ideal conditions for the slow and insidious formation of adhesions; this may well be described as the preadherent stage, and movement — not rest — is the basis of the restoration of function.

Now a word about adhesions. During the processes of repair and inflammation an exudate spreads and insinuates itself between the different structures, and where areolar tissue for mechanical reasons is loosely arranged it may spread far from the original point of irritation. The exudate covers the contiguous surfaces of neighboring structures, including the surfaces of the elements of muscles, tendons, fasciae and so on, and soaks its way into their interstices. This exudate, if it becomes coagulated and transformed into granulation tissue, causes the touching surfaces to become adherent. Later it may become organized, a fact of supreme importance in manipulating joints, because in the first stage the adhesions are easily separated but when organization has taken place the opposing surfaces are much more powerfully held and more difficult to separate, and on separation by manipulation a severe subcutaneous wound results. Prolonged rest greatly favors the formation of adhesions, and under favorable circumstances, adhesions form rapidly and lead to all degrees of limitation of movable parts. It is surprising how even slightly adherent parts will cause a constantly recurring painful irritation resulting in swelling, pain and dysfunction after use and how almost dramatically the freeing of such bound parts leads quickly to restoration of painless function. Although adhesions outside a joint occur in muscles and their sheaths, tendons, fasciae and capsules and the fatty pads round a joint, I am certain that adhesions even in a mild form in the delicate areolar tissue filling up the many spaces between the different structures of joints are extremely common and are a much commoner cause in preventing the free and easy movement of all joint structures on one another than is commonly believed. From the consideration of adhesion formation alone, treatment of injuries should aim at instituting at the earliest possible moment well controlled movements — i. e., muscle action — even in the early stages of inflammation. Thus by a gradual process of keeping contiguous parts on the move during the period of normal repair, adhesions will be prevented. Muscle action, also, as I have shown, plays a vital action in the efficiency of the whole circulatory system, arterial, venous and lymphatic, and I have strongly emphasized the importance of this fact, because to keep the tissue in a healthy state the regular normal fulfilment of these functions is essential. Likewise, when muscles are hypotonic and wasted, their efficiency and sensation of well-being are upset and the physical and chemical phenomena coincident with their normal activity are interfered with, causing a detrimental effect on the nutrition not only of the muscles but of all the neighboring tissues.

I fear that I may have crowded together somewhat rapidly many physiologic and pathologic facts in my effort to give you sound reason for advocating the undeniable importance of utilizing muscle action as the greatest aid to natural repair of inflamed joint tissue. The necessary stimulation can be achieved in two ways: (1) by muscle action voluntarily produced, which in the early and dangerous preadherent stage is not always possible for reasons of expediency or because excessive pain is produced; (2) by the correct application of the right type of electrical current, which in expert hands can be applied at the appropriate moment with perfect safety in all kinds of injured joints, even the most painful. By this method the electrical unit referred to reproduces under perfect control painless alternate contractions and relaxations of muscles and so reproduces the beneficial physico-

chemical changes resulting from muscle activity. In this way tone is restored, intermuscular and intramuscular adhesions are prevented by keeping tendons and other parts moving so that they do not become adherent to contiguous tissues and muscle wasting is also prevented. Above all, the blood and lymph supply to the damaged and surrounding parts is stimulated and the tissue fluids moved onward, so that the rate of repair is enhanced by encouraging the clearing away and rapid absorption of waste products.

It should be noted that a definite point of atonicity and wasting may follow injury, and when this is reached no amount of passive or voluntary exercises will cause complete redevelopment, even if accompanied with skilled and prolonged massage; whereas the response to the method of treatment I have described ends in certain and rapid recovery. So long as the nerve path is intact and the correct technic adopted, the rate of muscular redevelopment has to be seen to be appreciated.

When, as in the after-treatment of fractures, it may be inexpedient to allow joint movements or when by reason of pain or fear of pain or from muscle spasm, voluntary movements cannot be efficiently carried out, the contractions and relaxations of the muscles can still be produced without fear of harm. This is because the range and degree of contractions are under such perfect control that the muscles can be contracted singly or in groups without allowing their points of attachment to be approximated beyond the desired point, so that all the beneficial effects of muscle action are obtained without moving the joint itself or the broken ends of bone until recovery has advanced to the point at which a wider range of movement is desirable.

Muscular action does not mean only contraction. It is the complete sequence of events from the inception of a stimulus, which starts the action, to its cessation and includes the contraction of the principal muscle or group with shortening and broadening, the inhibition, relaxation and elongation of the opposing muscles and the subsequent relaxation of the contracting muscles until a condition of equilibrium is reached between the agonists and antagonists.

I think that one should look upon muscles in health as a composite body, and when certain movements are decided upon, unless each member of such composite body acts as a loyal accomplice to all the others, the perfect action designed to take place is instantly thrown out of gear, with a variety of maladjustments which may adversely affect the body as a whole.

I sincerely hope that my efforts to describe my reasons for emphasizing the profound importance of muscle action in relation to repair of damaged tissues has been of sufficient interest to encourage you to further research and to call attention to the huge number of disabled joints owing their crippled condition almost entirely to neglect of treatment designed to restore atonic and wasted muscle — a condition which all too frequently follows inflammation in joints, with disastrous effects if adequate steps are not taken to prevent it, at the earliest moment possible.

PHYSICAL THERAPY IN THE MANAGEMENT OF TENDON REPAIR *

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During World War II the management of tendon repairs afforded many refinements of physical therapeutic measures in the armamentarium of the physiatrist. Physical therapy, preoperatively and postoperatively, facilitated the surgeon's reconstruction of the part to be rehabilitated and cut down the number of hospital days. In addition to these advances, the physiatrist became an important member of the hospital staff by the use of physical medicine in the differential diagnosis for the severely wounded patients who have nerve injuries or present a major orthopedic problem.

It is the purpose of this paper to present the physical therapeutic measures applied in obtaining functional results following tendon transplantation and tendon grafts by surgical means.

The management of a transplanted muscle, a tendon graft, or a traumatically denervated muscle varies little clinically. Academically, however, the term "muscle reeducation" as applied to transplanted muscle or to denervated muscle has a different connotation when applied to tendon graft; the latter is considered as repair of the tendon of a muscle so that it will perform the same job as before repair, while the transplant and nerve injury are treated by more extensive muscle reeducation. The mechanism of innervation in a transplanted muscle, as expounded by Foerster[1] or Goldstein,[2] will not be considered, as the basic physical therapeutic principles remain the same in the over-all management, whether the tendon is grafted or transplanted.

The main objective of physical therapy in tendon repair is a planned, progressive week by week regimen, especially in the after-care, to give a strong functional results. This regimen requires the physiatrist to check the progress of the patient daily with the assigned therapist. For the therapist thoroughly to appreciate the repaired tendon, she should observe the actual surgical repair of the tendon in the operating room prior to the time therapy is begun, so that, after a period of immobilization, when the extremity is freed of a splint or plaster cast the therapist will use the utmost care. This prevents possible disastrous results.

Practically all surgical teachings and textbooks emphasize skilfully applied physical therapy as an important and helpful adjunct in securing successful results in the shortest possible time after operation for tendon repair.[3] Few texts have elaborated on "how or when" skilfully applied physical therapy should be instituted.

Garlock,[4] concluding from experiments made on dogs, reported in 1927, that safe motion could be instituted on the fifth day after operation and retention apparatus removed on the eighteenth day. Dowden,[5] in 1928, said that cut tendons should be so sutured that they would withstand early movement, and that after twenty-four hours the patient should be asked to move

* Read at the Twenty-Fourth Annual Session, American Congress of Physical Medicine, New York, Sept. 4, 1946.

1. Foerster, O.: The Cerebral Cortex in Man, Lancet 2:309, 1939.
2. Goldstein, K.: The Organism, New York,, American Book Company, 1939, p. 226.
3. Bunnell, S.: Surgery of the Hand, Philadelphia, J. B. Lippincott Company, 1944, p. 280.
4. Garlock, J. H.: Ann. Surg. 85:92, 1927.
5. Dowden, J. W.: Internat. J. Med. & Surg. 41:221, 1928.

the affected member very gently several times daily, with the range and force increased daily. Tailhefer,[6] in 1928, after using solid suture with linen thread, mobilized the finger on the day after operation as the best way of preventing adhesions.

Common today is still the conservative practice of immobilizing the repaired extremity for a six week period, during which time muscle atrophy, limitation of joint motion and formation of adhesions may take place.

Dittrich,[7] in 1927, from histologic studies, reported that too early and too prolonged movement may cause overproduction of callus and that the best time for beginning functional motion is the fourteenth day.

It is of interest that Schwartz,[8] in 1934, reported his review of 390 cases in which tendon suture was done in the surgical clinic of the University of Basel over a ten year period and that the commonest causes for failures were: (1) adhesions, (2) infection and (3) cutting through of the sutures.

The effect of function on healing is considered in this program only after the first fifteen days following surgical repair, in which time sufficient healing of the sutured cut tendons is permitted and the tendon fibers have formed across the gap. According to Bunnell,[3] by the end of the third week there is a fair degree of strength present, largely from formation of the strong tendon collagen fibers themselves. In the following program, it was found that carefully graduated physical therapy, using dry heat (infra-red radiation) followed by superficial type massage, muscle reeducation and graduated passive and active resistive exercise after the fifteenth postoperative day, aided an early return of strength.

The over-all management by physical therapy in tendon repair is as follows:

Preoperative Management

A diagnostic problem is often presented by crushing type injuries, gunshot wounds or high explosives, where there is a major orthopedic problem along with secondary nerve or tendon injuries or where the wound was due to a clean cut from glass, steel or a small bullet. The problem in major orthopedic cases is to determine whether inability voluntarily to move a part is due to a complete or partial nerve paralysis or is due to a severed tendon. Commonly, in compounded comminuted fractures, the resulting scar tissue and callus formation may be the cause for an apparent paralysis or severed tendons. In these diagnostic problems, by use of electrodiagnosis, muscle grading and peripheral nerve tests,[9] the physiatrist can aid the surgeon greatly. In fracture cases, after sufficient bony union is present, physical therapy is ordered for several reasons: to maintain and increase circulation; to maintain or increase joint motion; to prevent muscle atrophy and adhesion formation; to loosen scar tissue; to maintain or increase muscle strength and tone of the skin for future surgical repair.

Neurologic and severe orthopedic injuries that require tendon transplant or grafts have usually been immobilized for long periods, and in cases in which the infection has subsided the above indications for physical therapy are treated by the use of hydrotherapy followed by superficial effleurage with heavy effleurage and petrissage about the scar tissue followed by graduated active resistive exercise. In cases having partial or complete nerve injuries with lack of skin tone, the use of dry heat (infra-red radiation) is preferred to hydrotherapy prior to massage and exercise.

6. Tailhefer, A.: Presse Méd. 36:1337, 1928.
7. von Dittrich, K.: Arch. f. orthop. u. Unfall. Chir. 25:282, 1927.
8. Schwartz, A.: Results of Tendon Suture in the Hand, dissertation, Basel, 1934.
9. Wilson, G. D.: Arch. Phys. Med. 27:78, 1946.

Postoperative Management

The physical therapy regimen for tendon repair is begun fourteen days following operation at which time the sutured tendon is ready for functional movements.

First Week. — Radiant heat and superficial effleurage are used and are followed by active exercises at the table for tendon grafts and muscle reeducation for tendon transplants; reexamination includes range of joint motion.

Second Week. — Radiant heat and superficial effleurage are continued together with active resistive exercises with apparatus for the particular extremity. Muscle reeducation is continued in tendon transplants with the therapist offering resistance; maximum muscle power is not determined at this time as used in a heavy resistive exercise program.[10]

Third Week. — In tendon grafts radiant heat followed by progressive type, active, resistive exercises, the patient using a low number of repetitions (ten) with each added weight until a total of sixty to eighty repetitions is completed. In tendon transplants after preliminary heating by radiant heat to insure adequate circulation, active resistive progressive exercises as advocated in a heavy resistive exercise program are used.[10]

Reexamination is made at the end of the third week for functional result, and, of muscle power as measured on a dynamometer or by a person experienced in muscle grading, then the statement of maximum hospitalization can be made. For patients with more extensive tendon transplants, another week to two weeks of active, resistive progressive type exercises, is ordered. In determining maximum hospitalization or a complete functional result, muscle power was considered first and range of joint motion second.

Comment

Daily inspection is made by the physiatrist to insure the exact range of motion in the joint being exercised and the amount of resistance. Daily inspection has been found especially advisable in cases in which silk sutures have been used in the surgical repair. It was noted that when silk sutures were used either in the tendon suture or in the skin suture or in both repaired areas there was a greater tendency for collection of serum or for stitch abscess formation, apparently in spite of surgical antisepsis and regardless of the amount and type of physical therapy. It was noted that the experienced surgeon preferred other suture material to silk. The importance of knowing the type of suture material is stressed, especially in those cases of tendon repair in which a gliding surface of fascia was provided and the possibility existed that a silk suture knot would cause irritation in the gliding surface with consequent swelling.

The weekly reexamination by the physiatrist should include the measurement of improvement in joint motion by degrees, double check the therapist's progress of muscle reeducation, measure the increase in tendon strength or power, prescribe the new orders and demonstrate any exercise apparatus to the patient.

Physical therapy is administered only once a day, and occupational therapy is prescribed as the "follow-through," specific functional types of therapy projects being ordered to complete the patient's hospital day. The prescribed functional occupational therapy is more than just the functional type. It is a diversional therapy, as it allows a patient who has tendon repair to use his creative abilities and overcome any mental depression he may be harboring, the same as that which a neurologic patient often possesses while being treated for paralysis. Administratively, the tendon repair case is charted and prescribed for as a functional occupational therapy case.

10. DeLorme, M. C.: J. Bone & Joint Surg. 27:645-667, 1945

Report of Cases

CASE 1. — A 22 year old soldier cut his left wrist on a piece of glass when he fell through a hole in the first floor onto a pile of debris in the basement of a house shelled in Luxembourg. He sustained a severe lacerating wound of the left wrist, severing the flexor tendons. A tendon repair was done the same day with the left forearm immobilized in splints and plaster cast for three months. Following the period of immobilization he received three weeks of physical therapy overseas.

When the patient was referred to the physical medicine department to strengthen his fingers, examination revealed a curved incisional scar on the ulnar side of the volar surface of the left wrist (fig. 1).

It was noted when the fourth finger was passively extended the scar moved with the tendon. There were no motor or sensory nerve changes. Hydrotherapy, heavy massage and passive and active finger and wrist exercises were administered for two weeks as a preoperative measure.

At operation it was found that the distal ends of two central tendons of the flexor digitorum sublimis were bound down in scar tissue and some adhesions (fig. 2).

Free grafts were made from the common donor, the palmaris longus tendon (fig. 3). The hand was put in slight dorsiflexion and the finger in three-fourths extension. The plaster cast remained fourteen days, after which time physical therapy was started.

The regimen of physical therapy previously outlined was administered (fig. 4).

Fig. 1 (Case 1). — Flexion contracture following injury to flexion tendons that simulated a nerve injury.

For early active resistive exercise for the flexor digitorum sublimis a sponge rubber block measuring 2½ by 3½ inches was used (fig. 5).

The total range of the wrist motion obtained was 125 degrees (fig. 6). Excellent muscle power was regained as measured on the hand dynamometer (fig. 7). Patient received total of twenty-nine physical therapy treatments.

CASE 2. — A 28 year old soldier was injured on Nov. 11, 1944, by high explosive fragments in Lyon, France, which caused a severe penetrating wound of the left lower leg. He received penicillin therapy with débridement on the same day. Sixteen days later the additional diagnosis of a spreading infection from the wound, between the muscle plane and along the extensor hallucis longus tendon, was made. He was evacuated to a numbered hospital, where incision and drainage under sodium pentothal anesthesia were done. One month later the patient had secondary closure followed by application of a cast. At end of fourteen days the cast was removed and the patient was evacuated to a named general hospital in the United States three months after injury. Four months after injury a repair to the anterior tibialis was performed by a free tendon graft.

At operation there were found a gap of 4 inches between the ends of the severed anterior tibialis tendon and a 6 inch gap in the extensor hallucis longus tendon, which was considered too great for tendon graft (fig. 8).

The freed muscle belly end and the freed distal end of the tendon were sutured to the extensor digitorum communis after removal of the septum between the muscles. The remaining portion of the distal end of the extensor hallucis longus (4½ inches) was used to connect the proximal and distal ends of the anterior tibialis (fig. 9). The freed muscle belly end and the freed distal end of the tendon were sutured to the

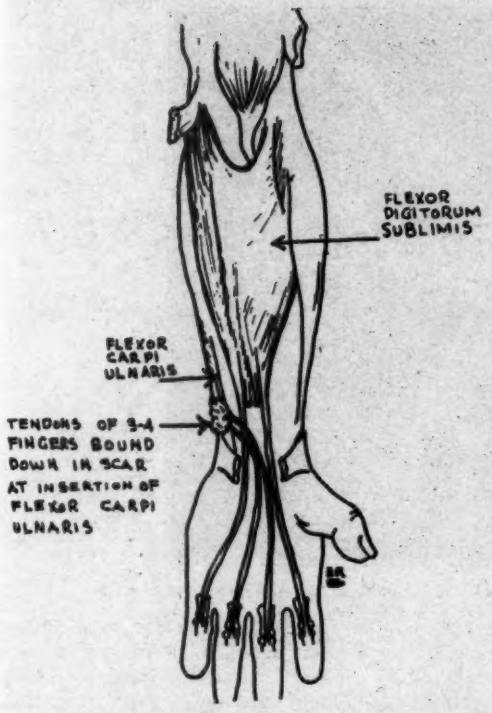

Fig. 2 (Case 1). — Findings at operation. The flexor tendons of the third and fourth fingers are bound down in scar tissue.

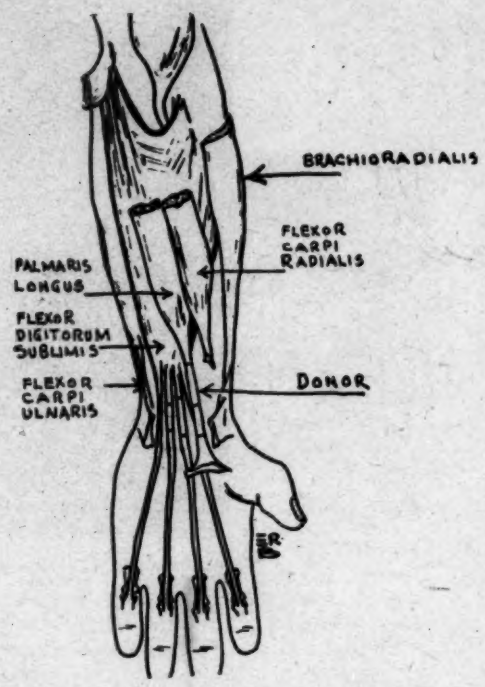

Fig. 3 Case 1). — Surgical repair of the tendons

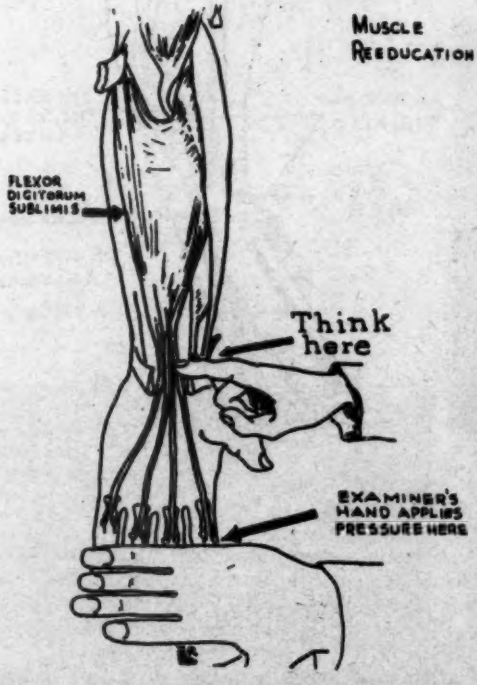

Fig. 4 (Case 1). — Basic principle of muscle reeducation by stroking lightly the specific tendon to be moved voluntarily.

Fig. 5 (Case 1). — Use of sponge rubber block. By means of the block, measuring 2½ by 3½ inches, the flexor digitorum sublimus muscle to be exercised against slight resistance.

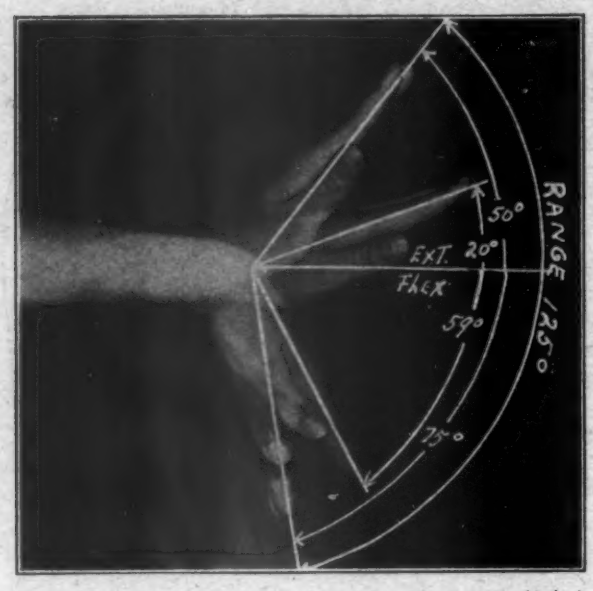

Fig. 6 (Case 1). — Range of wrist motion gained from physical therapy (quadruple exposure).

Fig. 7 (Case 1). — Use of hand dynamometer to measure muscle power regained.

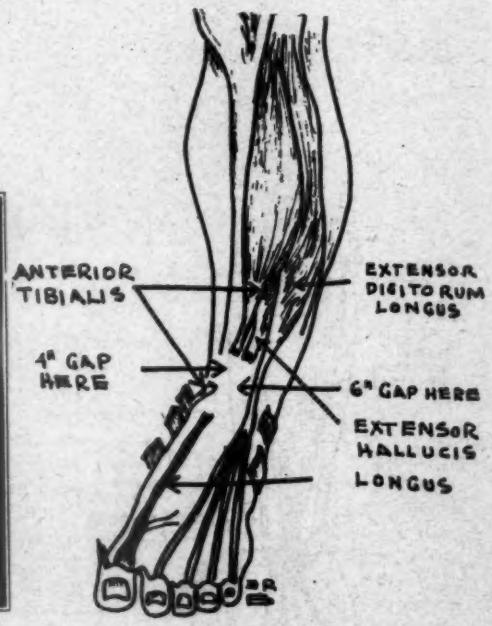

Fig. 8 (Case 2). — Findings at operation

extensor digitorum communis after removal of the septum between the muscles. The remaining portion of the distal end of the extensor hallucis longus (4½ inches) was used to connect the proximal and distal ends of the anterior tibialis (fig. 9). The plaster cast was removed after eleven days and the previously outlined regimen of physical therapy instituted (fig. 10).

At the first examination in the physical therapy department a total range of ankle motion was 3 degrees, dorsiflexion being 0. At the end of the second week of therapy the total range of ankle motion was 22 degrees. During the third week non-weight-

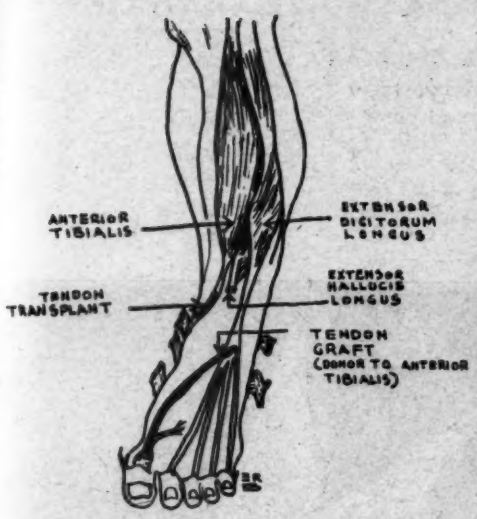

Fig. 9 (Case 2). — Surgical repair of the tendons

Fig. 10 (Case 2). — Institution of muscle reeducation to regain use of the anterior tibialis muscle.

bearing type active resistive exercises were given (fig. 11). The fourth week heavy resistive weight bearing exercises were given (figs. 12 and 13),with a resulting total range of ankle motion 32 degrees. After five weeks of physical therapy the following results had been obtained: postoperative dorsiflexion, Q; plantar flexion, 32 degrees; range, 32 degrees, and power, excellent (fig. 14).

Fig. 11 (Case 2). — Non-weight-bearing type of active resistive exercise.

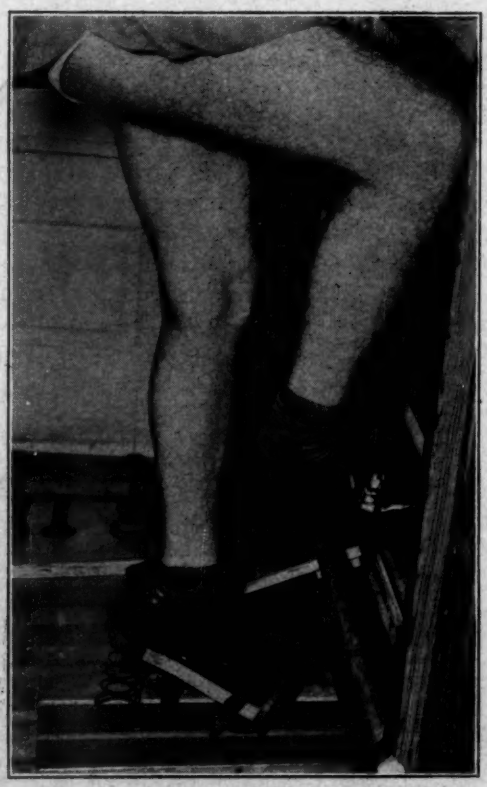

Fig. 12 Case 2). — Body-weight-bearing type of active resistive ankle exercise.

Fig. 13 (Case 2). — Active resistive exercise, progressive after each measured lap.

Fig. 14 (Case 2). — Range of ankle joint motion regained by physical therapy following surgical repair of the tendons (double exposure).

Summary

A plan of progressive physical therapy is presented that enhances the surgical measures and, more important, rehabilitates the patient in fewer hospital days and allows the patient to return physically fit to a self-sustaining position in his community at an earlier date.

The place the physiatrist takes in the hospital staff team and the important job he can do in rehabilitation of patients with tendon injuries are pointed out.

The important points to be considered by the physiatrist are discussed.

Typical cases of upper and lower extremity tendon repair are presented with illustrations.

Discussion

Dr. Bert A. Treister (Cleveland): Dr. Wilson has described in detail an excellent program of physical therapy in the management of tendon repair. He stressed the importance of both preoperative and postoperative measures. Preoperatively, heat, deep massage and active exercise assist in mobilizing adherent structures to facilitate surgery. Because it seemed to soften the scar, I almost routinely employed ion transfer with sodium chloride in these cases. My experience in the management of tendon repair parallels that of Dr. Wilson in that judiciously applied early treatment resulted in a more rapid return of good function. Our surgeons, following the method of Bunnell, usually waited three weeks before starting physical measures. It seems that the prime benefit of early treatment lay in its ability to prevent postoperative adhesions between the tendon and surrounding structures. Often I have noticed that a rather insignificant-appearing adhesion between a muscle or tendon and its overlying skin was sufficient to create considerable disability in that muscle, at times, simulating a complete paralysis.

ENERGY COST OF EXERCISES FOR CONVALESCENTS *

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The importance of physical activity for a more efficient convalescence recently has received strong support.[1]

Although the physical conditions of patients vary a great deal, one general rule is applicable to all of them; a ward exercise program should be arranged so that the strenuousness of exercises is low on the day the patient leaves his bed, and gradually increases with each day of exercise.

The reason for such a rule is obvious; it helps to avoid undue strain upon the heart and the muscles. The excess strain imposed upon skeletal muscles can do hardly any harm outside of fatigue and soreness, but the strain imposed upon the heart during the early period of convalescence after a disease which might have involved the cardium may be harmful and therefore should be avoided.

Heretofore, most grading of exercises has been done by comparing exercises with respect to the size of the muscle groups involved, the part of the body used and the cadence of the exercise. This gives, at best, an inaccurate estimate and may lead to surprisingly large errors, as shown experimentally by Missiuro and Perlberg.[2] Thus there is need for a more reliable and objective gradation of exercises. Accordingly, the present study was undertaken. In it the amount of energy spent in the execution of various exercises was measured objectively by determining the amount of oxygen used.

However, since the oxygen consumption for an exercise has only relative value, being naturally greater in large men and less in smaller men, energy cost must be expressed in a more explicit manner. For this reason, resting oxygen consumption was taken as the unit of measurement, and the net cost of each exercise was expressed in these units. Henceforth, in this report, "energy cost" refers to oxygen consumption expressed in multiples of the resting metabolic rate. Since work of the heart during an activity which does not incur a large oxygen debt is proportionate to the total amount of oxygen used, the data indicating the intensity of an exercise can also be used for an estimation of the increase of the work of the heart itself.

Procedure

In the present study a closed circuit metabolism apparatus was used (fig. 1). It consisted of a 100 liter Tissot spirometer, filled with oxygen, and a 4 liter canister,

* This study was conducted at the Physical Fitness Laboratory of the AAF School of Aviation Medicine, Randolph Field, Tex.

1. Harrison, T. R.: Abuse of Rest as a Therapeutic Measure for Patients with Cardiovascular Disease, J. A. M. A. 125:1075, 1944. Eastman, N. J.: The Abuse of Rest in Obstetrics, ibid. 125:1077, 1944. Powers, J. H.: The Abuse of Rest as a Therapeutic Measure in Surgery, ibid. 125:1079, 1944. Dock, W.: The Evil Sequelae of Complete Bed Rest, ibid. 125:1083, 1944. Ghormley, R. K.: The Abuse of Rest in Bed in Orthopedic Surgery, ibid. 125:1085, 1944. Menninger, K.: The Abuse of Rest in Psychiatry, ibid. 125:1087, 1944. Karpovich, P. V.: Starr, M. P., and Weiss, R. A.: Physical Fitness Tests for Convalescents, ibid. 126:873, 1944. Karpovich, P. V.; Starr, M. P.; Kimbo, R. W.; Stoll, C. G., and Weiss, R. A.: Physical Reconditioning After Rheumatic Fever, ibid. 130:1198, 1946. Robertson, H. F.; Schmidt, R. E., and Feiring, W.: The Therapeutic Value of Early Physical Activity in Rheumatic Fever, Preliminary Report, Am. J. M. Sc. 211:67, 1946.

2. Missiuro, W., and Perlberg, A.: Research in Effect of Gymnastics Upon Metabolism, Arbeitsphysiol. 9:514, 1937.

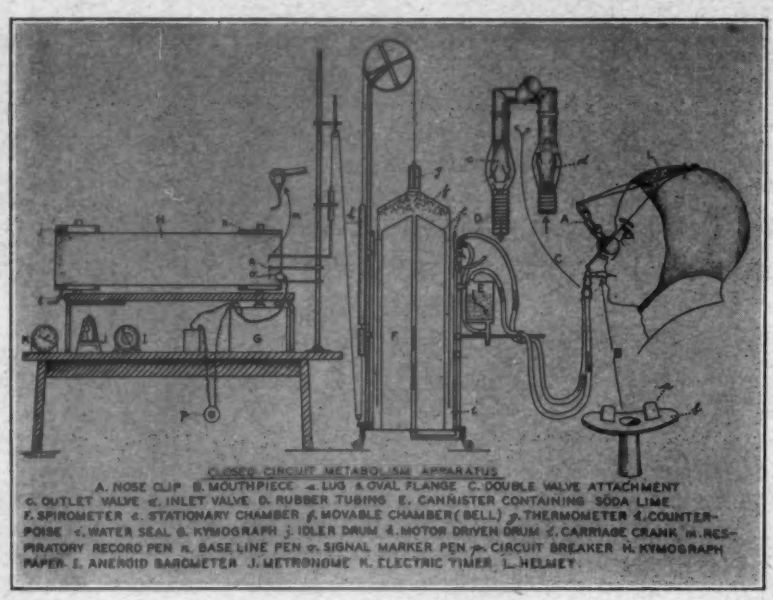

Fig. 1

containing soda lime, placed in the circuit outside of the spirometer. The subject breathed through a mouthpiece with two one way valves. The mouthpiece was connected with the spirometer by means of two pieces of corrugated rubber tubing each 6 feet long and 1 inch in diameter. Oxygen was inspired through one tube. The expired gases passed through the other tube into the canister, where the carbon dioxide was absorbed, leaving oxygen to be returned to the spirometer. The tubing was carefully secured to the subject's chest in order to avoid a pull on the mouthpiece during exercise.

A kymographic record of the subject's respiration (movements of the spirometer bell) during the testing periods was obtained by means of a pen point on a vertical rod which was attached by a thread to the spirometer (fig. 2). Another pen was used

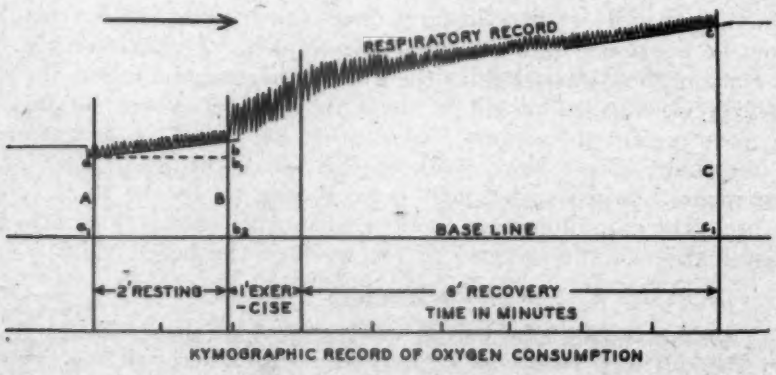

Fig. 2 — Kymographic record of oxygen consumption.

to record a base line, while a third was used as a timing signal marker.

All measurements were done on one subject, an aviation student having a calm and steady temperament. These qualities were indispensable in assuring a regular respiratory pattern and a uniform execution of movements. The subject was 24 years old, 66.5 inches in height, and weighed 130 pounds.

To orient the subject with procedures, several preliminary tests were conducted at the beginning of the experimental series. To assure uniform performance, he prac-

ticed each exercise a day in advance of the test for that exercise. The testing was conducted both in mornings and afternoons, starting approximately two and one-half hours after meals.

The test for each exercise consisted of a two minute rest period, a one minute exercise period[3] and a recovery-after-exercise period which lasted until the subject's respiration apparently had returned to its resting state and remained there for at least two minutes. Also, at the beginning of each daily series of experiments, resting metabolism was tested for ten minutes. The resting and recovery records were made with the subject in a sitting position. All exercises except one (dips, front leaning rest) were performed from a standing, sitting or lying position. The sitting and lying exercises were performed on a table placed next to the metabolism apparatus.

The subject was tested with each exercise at least twice. Wherever the difference in cost of the same exercise exceeded 30 per cent of the lower value, the exercise was repeated until the difference was reduced to less than 30 per cent.

Barometric pressure and the temperature of the gas in the spirometer were recorded during each test for use in converting the oxygen data to volumes at standard temperature and pressure, dry. All testing was done in an air-conditioned room with the temperature at approximately 77 F.

Analysis of the Data

In order to ascertain the energy cost for each exercise, the following determinations were made:

1. Oxygen consumption per minute during rest (resting metabolic rate).
2. Gross oxygen consumption during exercise and recovery-after-exercise.
3. Net oxygen consumption, which is the amount of oxygen consumed in the performance of the exercise and recovery-after-exercise over and above that used in the resting state for the same period of time.
4. Energy cost of exercise expressed in multiples of resting metabolism.

All calculations pertaining to oxygen were made from kymographic records. Figure 2 shows a typical record of a test. Reading from left to right the record shows a two-minute rest period, a one minute exercise period and a six minute recovery period. The last two minutes of each recovery period were used to determine the resting oxygen consumption rate.

Resting metabolism was determined by measuring the difference in the levels of the spirometer bell at the beginning (line A) and end (line B) of the two minute rest period (fig. 2). This difference, bb_1, found by subtracting aa_1 from bb_2 was changed to liters of oxygen by use of a conversion factor (1 cm. corresponding to 1.304 liters). Dividing this amount by the number of minutes between A and B, which in this case was 2, gives the resting metabolic rate per minute. Altogether, 86 determinations of resting metabolism were made, and the average, 0.282 liter per minute, was used in this study.

Gross oxygen consumption for each exercise was determined in the same manner as resting metabolism by measuring the difference between the levels of the spirometer at the beginning of the exercise period and at the end of the recovery period.

The net exercise metabolism was calculated by using the formula $(C\text{-}B) - t \times RM$, where $(C\text{-}B)$ is the gross oxygen consumption during exercise and recovery, t is the exercise plus recovery time (7 minutes in this case) and RM is the mean resting metabolic rate. All oxygen data were converted to volumes at standard temperature and pressure, dry.

The two determinations of net oxygen consumption for each exercise having a difference of less than 30 per cent were averaged. In most cases this difference was less than 10 per cent, the average being 11.3 per cent.

The energy cost for each exercise was determined by dividing the average net oxygen consumption for one minute by the average resting metabolic

3. A few exercises which appeared to be too strenuous to continue as long as the others were performed for less than a minute.

rate. The result is an expression of the number of times that the net exercise metabolism is raised above the average resting metabolic rate.

Figures 3 to 6 illustrate the 42 exercises used in this study, arranged in order of increasing energy cost. To the right of each exercise is found the net cost in terms of resting metabolism. It will be noted that these figures range from 1.2 to 9.3. The number of repetitions of each exercise per minute can be found by dividing the cadence (*C. P. M.*) by 4.

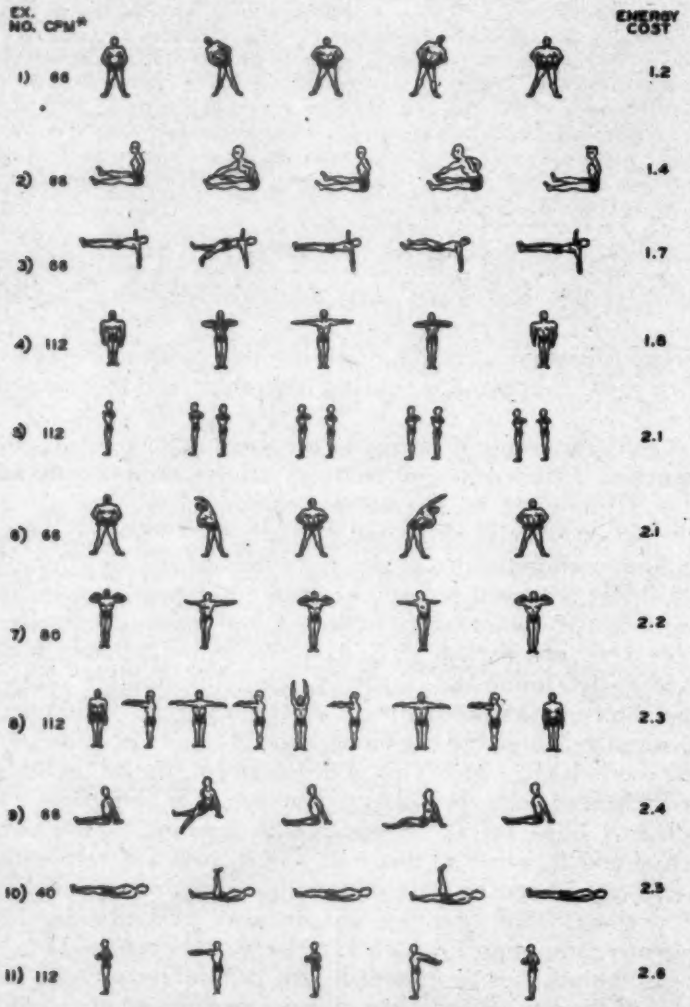

Fig. 3. — Energy Cost of Exercises

*CPM = counts per minute.

NOTE. — The first figure in each exercise shows the starting position for that exercise. All exercises are performed in four counts, except exercise 8, which is performed in eight counts. For example, in exercise 1, the count is: 1, trunk bent right; 2, return; 3, trunk bent left; 4, return.

Exercise 5. — Two figures represent each count: 1, elbows back and return; 2, elbows back and return; 3, elbows back and return; 4, elbows back and return.

Exercise 8. — The alternate figures in this exercise show the side view.

Comment

In a subsequent study conducted on 30 subjects it was found that there was significant variation in energy cost among subjects for the same exercise.[4] This variation is sufficient to alter somewhat the order of intensity of

4. Weiss, R. A.: Variability in the Energy Cost of Selected Exercises, Project No. 374, Report No. 1, AAF School of Aviation Medicine, Randolph Field, Tex., Nov. 20, 1945.

exercises for different subjects. For this reason, the cost list given in this article is accurate only for the experimental subject. However, this list offers an approximate estimation of energy cost of these exercises for other subjects and may be used as a guide for prescribing exercises.

Suggestions for Constructing a Ward Exercise Program

Since the physical conditions of patients vary a great deal, depending upon the extent of their fitness before the onset of illness and also upon the

Fig. 4. — Energy Cost of Exercises

*CPM = counts per minute.

Exercise 13. — Second to fifth figures show first two counts of this exercise: 1, trunk bent right, return half way; 2, trunk bent right, return half way; 3, trunk bent right; 4, return.

Exercise 18. — Second and third figures show the side view

Exercise 19. — The right knee is raised in the second figure, and the left knee is raised in the fourth figure.

severity of the disease, a ward exercise program should be adjusted to the individual capacities of the patients. In large hospitals it would be impractical for a physical instructor to give training to each patient individually; therefore, adjustment should be made within the program.

In conducting a ward exercise program, it is impossible to have a progression in strenuousness from day to day, because new patients may start taking physical training any day of the week. Progression can be obtained, however, by arranging exercises for each daily period in order of increasing

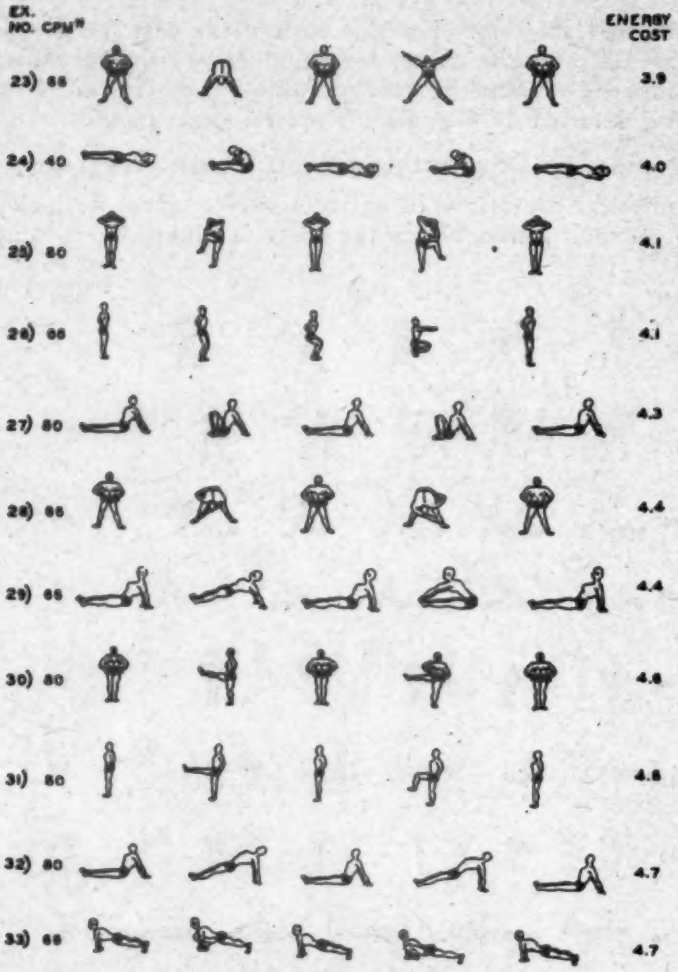

Fig. 5. — Energy Cost of Exercises
*CPM = counts per minute.
Exercise 30. — The second figure shows the side view.

intensity, starting with the mildest and ending with an exercise of a desired maximum intensity. In this manner, it becomes a simple matter to schedule a patient for either a part of or the entire period, depending on his condition.

TABLE 1. — *Samples of Ten Minute Series of Ward Exercises for Convalescent Patients.*

Sample 1 Exercise Number	Energy Cost	Sample 2 Exercise Number	Energy Cost
4	1.8	8	2.3
7	2.2	11	2.6
18	3.3	16	3.1
19	3.3	22	3.8
24	4.0	23	3.9
27	4.3	30	4.6
35	5.1	33	4.7
37	5.7	36	5.1
38	6.2	39	6.5
41	7.6	40	6.8

Although daily programs should follow the same pattern of intensity, this does not imply the use of identical exercises. For psychologic reasons exercises should be varied in type, although remaining within the same energy cost limits. Any physical instructor can make his own program, se-

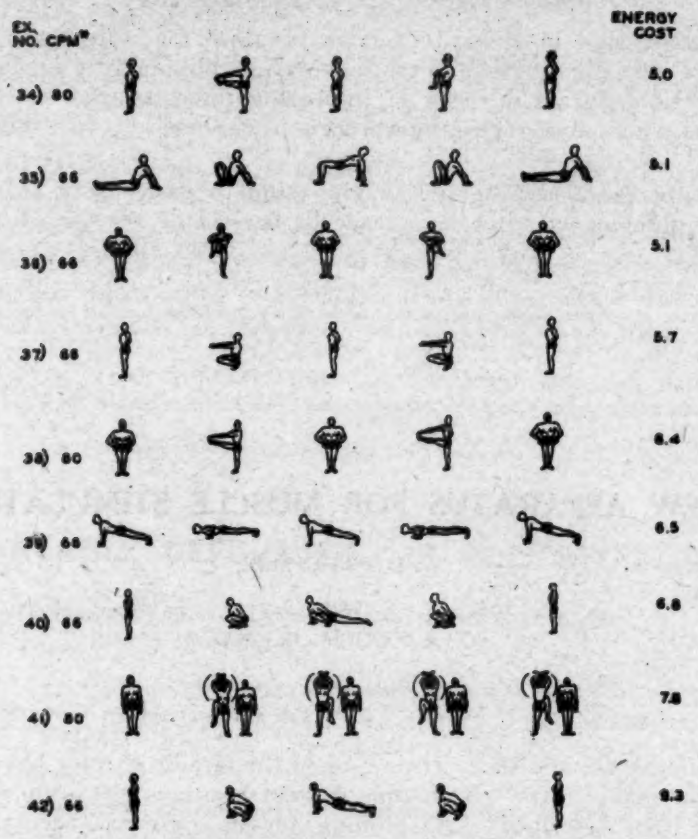

Fig. 6. — Energy Cost of Exercises

*CPM = counts per minute.

Exercise 38. — Fingers touch toes of the opposite foot. The second and fourth figures show the side view.

Exercise 41. — Two figures represent each count: 1, right knee raised and returned, arms circled outward; 2, left knee raised and returned, arms circled outward; 3, repeat count 1; 4, repeat count 2.

TABLE 2. — *Sample of Ten Minute Series of Ward Exercises for Patients Convalescing from Rheumatic Fever.*

Exercise Number	Energy Cost
5	2.1
7	2.2
12	2.8
14	2.9
19	3.3
23	3.9
25	4.1
30	4.6
32	4.7
33	4.7

lecting exercises from the "cost list." As a guide, sample programs for two days are given in table 1. These programs have been found suitable for patients recovering from infections of the upper respiratory tract. Patients recovering from more debilitating diseases should be given exercises having a narrower range of intensity. Table 2 shows a sample ward exercise program for patients convalescing from rheumatic fever.

Summary

1. The intensity of an exercise measured by the amount of oxygen used in its execution may be conveniently expressed in terms of resting metabolism.

2. Progression in a ward exercise program for convalescent patients at different levels of physical condition may be obtained by arranging each daily exercise program in order of increasing intensity and scheduling the patients for as much of each program as is commensurate with their physical abilities.

3. Daily exercise programs having similar patterns of intensity but containing different exercises may easily be devised by the use of an exercise "cost list."

Acknowledgment is given here to Steve G. Dunski, formerly aviation student, Randolph Field, Tex., for his assistance as subject in the experiment, and to Terry Robinson, formerly at the AAF Regional Hospital, San Antonio Aviation Cadet Center, San Antonio, Tex., for the original drawings in figures 3 to 6.

A NEW APPARATUS FOR MUSCLE STIMULATION *

W. D. PAUL, M.D.

and

O. A. COUCH, JR., M.D.

IOWA CITY

The diagnostic and therapeutic uses of the faradic current have been recognized for many years. Numerous devices for the application of this current have been described. Outstanding among these has been the Morton Smart Faradic Coil. This coil has been used to test for the reaction of degeneration, to produce contractions of innervated muscles which the patient cannot or will not move and to treat hysteria. The disadvantage of the Smart Coil is that its mercury interrupter requires much care and adjustment. For some time we have been looking for a machine which does not have this drawback. We now wish to describe a muscle stimulator which has been found useful and which has advantages over those previously described.[1]

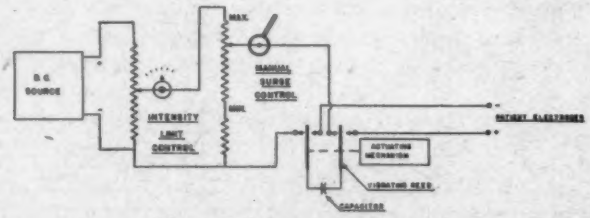

Diagram of the muscle stimulator

The device consists of a direct current source, an intensity limit control, a manual surge control and an actuating mechanism composed of a capacitor and a vibrating reed (see diagram). The patient is put into the circuit by the use of an indifferent electrode and a testing electrode with a finger-controlled current interrupter. The machine operates from the usual 115 volt, 60 cycle current.

The principle of operation is simple. The vibrating reed serves as a double pole, double throw switch which alternately charges the capacitor from the direct source and then discharges it into the patient. The charge and discharge repeat continuously at a constant rate governed by the frequency of the vibrating reed. The operator causes the stimulator current to surge at the desired rate and wave form by operating

* From the Department of Physical Medicine, State University of Iowa.

1. Furnished by the Burdick Corporation, Milton, Wis.

the manual surge control level. The surge control is operated in the full range between minimum and maximum, and the magnitude of the current is limited by the position of the intensity limit control. The intensity limit control is set at a position to give the maximum desired current when the manual surge control is on maximum.

During the last epidemic of poliomyelitis it was found that even in a patient with apparent flaccid paralysis a strong enough current might produce some degree of motion if the muscles were only partially denervated. This machine has proved to be of value diagnostically and in the treatment of weaknesses due to acute anterior poliomyelitis. The instrument has been used both diagnostically and in the treatment of nerve injuries, fractures and arthritis. Its portability, its simplicity of operation, its sturdiness and its freedom from need of adjustment are the advantages of this stimulator.

PREVENTABLE DEFORMITIES IN POLIOMYELITIS

COMMANDER EDWARD W. LOWMAN (MC), U. S. N.

The value of physical medicine in the management of acute anterior poliomyelitis is in inverse proportion to the time lapse prior to the institution of treatment. The touchstone to the best results is not only good treatment but early treatment.[1]

While the concensus of the best authorities is not in total agreement with the concepts and routine advocated by Miss Elizabeth Kenny,[2] still few persons have escaped permeation by her distinct contribution to the concept and treatment of the disease,[3] and as a result there have arisen a myriad of so-called modified Kenny regimens and simply modified regimens, the latter without admitted credit to Miss Kenny. Of her practices, those most unanimously accepted have been the method of hot-packing in the acute stage and her system of muscle reeducation based upon her superior functional classification of muscles.

As a result of the proliferative evolution wrought, the treatment of poliomyelitis in the past five years has snowballed from the sphere of the orthopedist into that of the medical specialist in physical medicine, with the consequence that the former now is concerned most or solely with reconstructive orthopedic surgery in the final rehabilitation stage.

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1. (*a*) Kabat, H., and Knapp, M. E.: Mechanism of Muscle Spasm in Poliomyelitis, J. of Pediat. 24: 123, 1944. (*b*) Compere, E. L.: Management and Care of the Infantile Paralysis Patient, Arch. Phys. Therapy 24:709, 1943. (*c*) Hipps, H. E.: Muscle Behavior Following Infantile Paralysis, Am. J. Surg. 53: 314, 1941.

2. (*a*) Pohl, J. F., and Knapp, M. E.: The Kenny Method of Treatment for Infantile Paralysis. The National Foundation for Infantile Paralysis, Inc., Publication No. 40, 1940. Pohl, J. F., and Kenny, E.: The Kenny Concept of Infantile Paralysis and Its Treatment, Minneapolis, The Bruce Publishing Company, 1943.

3. (*a*) Cole, W. H.; Pohl, J. F., and Knapp, M. E.: Kenny Method of Treatment for Infantile Paralysis, Arch. Phys. Therapy 23:399, 1942. (*b*) Lewis, P.: Kenny Treatment of Infantile Paralysis During the Acute Stage, Illinois M. J. 81:218, 1942. (*c*) Knapp, M. E.: Kenny Treatment for Infantile Paralysis, Arch. Phys. Therapy 23:668, 1942. (*d*) Pohl, J. F.: Kenny Treatment of Anterior Poliomyelitis: Report of First Cases Treated in America, J. A. M. A. 118:1428, 1942. (*e*) Daly, M. M. I.; Greenbaum, J.; Reilly, E. T.; Weiss, A. M., and Stinson, P.: Early Treatment of Poliomyelitis with Evaluation of the Sister Kenny Treatment, ibid. 118:1433, 1942. (*f*) McFarland, W. J.: Kenny Treatment in Poliomyelitis, California & West. Med. 61:1, 1944. (*g*) Cole, W. H., and Knapp, M. E.: The Kenny Treatment of Infantile Paralysis, J. A. M. A. 116:2677, 1941. (*h*) Boines, G. J.: The Use of Prostigmine and a Modified Kenny Technic in Treatment of Poliomyelitis, J. Pediat. 25:414, 1944. (*i*) Steindler, A.: Clinical Observations on Infantile Paralysis and Their Therapeutic Implications, J. Bone & Joint. Surg. 24:912-921, October, 1942. (*j*) McCarroll, H. R.: The Role of Physical Therapy in Early Treatment of Poliomyelitis, J. A. M. A. 120:517, 1942. (*k*) Ober, F. R.: Early Management of Poliomyelitis and the Kenny Treatment, Connecticut M. J. 7:16, 1943. (*l*) Ransohoff, N. S.: Experiences with Kenny Treatment for Anterior Poliomyelitis in the Epidemics of 1942, Monmouth and Ocean Counties, N. J., J. Bone & Joint Surg. 26:99, 1944. (*m*) Key, J. A.: Indications for and the Limitations of Treatment of Poliomyelitis, J. Pediat. 26:265, 1945. (*n*) Fischer, A. E.: Evaluation of Kenny Treatment of Poliomyelitis, J. Mt. Sinai Hosp. 12:200, 1945. (*o*) Compere.1b (*p*) Pohl and Knapp.2a

Unfortunately, there is still a relative dearth of personnel properly trained and adequately experienced to administer good poliomyelitis care, and, consequently, poor results as a consequence of questionable adequacy in therapy have not been infrequent. Furthermore, the expense of necessarily prolonged care with Kenny methods has often prohibited or restricted its use to a degree of questionable adequacy.

The status of the phenomenon of muscle spasm in poliomyelitis has been subjected to exhaustive investigation in the past few years since the stimulating American debut of Miss Kenny in 1941. Spasm in poliomyelitis now is no longer considered a phenomenon related solely to meningeal irritation.[4] It is a reflex phenomenon, the result of release of proprioceptive fibers from higher centers of inhibition,[4] and probably reflects internuncial cell damage. This latter concept was originally propounded and investigatively pursued by Kabat and Knapp.[1a] The report of Minckler [5] showing extensive internuncial cell damage in postmortem studies of poliomyelitic spinal cords has supported this line of thought. Accordingly, a central action at internuncial cell synapses might well explain the antispastic effect of the vagotonic drug Neostigmine, the effective use of which has recently found considerable space in the literature.[6] In electromyographic studies, Schwartz [7] has verified conclusively the existence of the phenomenon, spasm. Furthermore, he has shown that spasm may be present without weakness in the antagonist muscle or it may occur per se in a weakened muscle.

Spasticity, therefore, does not necessarily reflect damage to anterior horn cells. Basically, then, spasticity and weakening are separate phenomena of the disease process.

Muscle shortening in poliomyelitis is the result of unreleased muscle spasm and is the basis for development of contractures; deformity is the end result of the latter. Early treatment has as one major objective the prevention of this cycle: spasm — shortening — contracture — deformity. Deformities fundamentally are the result of unreleased muscle spasm; less frequently they may occur as a result of tightness secondary to prolonged immobilization either with or without splints.

Good regimens of physical medicine treatment have been numerously reported in the literature;[8] that which I have recommended and employed is discussed elsewhere.[9]

In 1944, the Bureau of Medicine and Surgery of the Navy established in one of its continental hospitals a center for the treatment of poliomyelitis occurring among Navy and Marine personnel. The care and management of these patients became the responsibility of the Department of Physical Medicine. Technician personnel were carefully selected from among WAVE registered technicians who had had extensive civilian experience in poliomyelitis work. Patients were segregated for uniformity in handling, and the rehabilitation program for each patient was closely supervised and individually directed. Total rehabilitation was the foremost objective, with hospitalization time not primarily a consideration. Over a period of two years,

4. Muscle Spasm in Poliomyelitis, Current Comment 1a, J. A. M. A. 125:35, 1944. Kabat and Knapp.1a
5. Minckler, J.: Pathologic Alterations in Surface Relationships and Morphology of the Human Synapse, Am. J. Path. 18:1061, 1942.
6. (*a*) Brainerd, H.; Katz, H. J., and Rowe, A. P., Jr.: Clinical Manifestations of Poliomyelitis: Treatment with Neostigmine and the Kenny Method, J. A. M. A. 128:718, 1945. (*b*) Spankus, W. H., and Fox, M. J.: Value of Neostigmine in Acute Anterior Poliomyelitis, ibid. 128:720, 1945. (*c*) Kabat and Knapp.1a (*d*) Boines 3h
7. Schwartz, R. P., and Bouman, H. D.: Degree, Extent, and Mechanism of Muscle Spasm in Infantile Paralysis, N. Y. State J. Med. 44:147, 1944; Muscle Spasm in Acute Stage of Infantile Paralysis as Indicated by Recorded Action Current Potentials, J. A. M. A. 119:923, 1942.
8. Hipps, H. E., and Crook, B. L.: Early Treatment of Infantile Paralysis, Arch. Phys. Therapy 25:403, 1944. Smith, E. M., and Crook, B. L.: Underwater Therapy at Spas, J. A. M. A. 124:506, 1944. Compere.1b Knapp.3c McFarland.3f Steindler.3i Ober.3k Ransohoff.3l Brainerd, Katz and Rowe.6a Spankus and Fox.6b
9. U. S. Nav. M. Bull., to be published

88 patients were received at this hospital for treatment. Hospitalization from onset averaged twelve months.

With the exception of two small epidemics, cases were sporadic in nature occurring on all parts of the globe from Naples to China, from Brazil to Alaska, and patients were transferred rapidly or ultimately for treatment in the special center. Delay in receipt of patients from time of onset of the acute phase of illness varied widely, from seventeen days to eleven months, depending in most cases upon the situational exigencies imposed by the war. In only a few instances were facilities at hand locally for providing the highly specialized care required in the acute stage. It was realized that such circumstances would be conducive not to the best results but to the maximal in the light of the circumstances. In these patients, receiving as they did varied sorts of treatment for varying lengths of time prior to transfer, a scale of relative efficacy of treatment soon became apparent in terms of contractures, early deformities and frank deformities which were encountered.

Patients treated early with Kenny packing and stretching uniformly presented fewer contractures and deformities upon receipt at the special center; the longer the delay in transit, when correlated with a medicinal palliative regimen of therapy, the greater the tendency toward contractures and deformity. However, in patients with minimal spinal cord damage, as evidenced by only low grade residual weakness, contractures and deformities were surprisingly infrequent. Contractures and deformities were always accompanied by residual weakness, though the relationships of the two (weakness and spasm) were not significantly correlated insofar as agonists, antagonists, etc., were concerned, a clinical finding substantiating the findings of Schwartz.[7]

The longer the existence of a contracture or a deformity prior to the institution of physical therapy, the worse was the prognosis for correction. The more rapidly the elimination of spastic muscular states in the acute stage, the less was the likelihood of progression to contractures. The earlier the relief of spasm, the better was the prognosis for return of function in alienated or weakened antagonists through early application of reeducation exercises in those cases in which the two (weakness or alienation plus spasm) presented themselves in related agonist and antagonist groups.

Among the 88 patients received for treatment over the two year period the deformities encountered most commonly were the following:

1. *Gastrocnemius Contracture* (Fig. 1). — In gastrocnemius contracture with secondary foot drop, the primary pathologic change from a therapeutic standpoint is the shortening of the gastrocnemius muscle and its Achilles tendon, even though the muscle weakness is all anterior tibial. It is true that the two may be associated — i. e., muscle spasm and antagonist muscle weakness — but, on the other hand, the apparent antagonist weakness may be attributable solely to the dysfunction of the antagonist muscle or group, the so-called alienation phenomenon of Kenny. Until the mechanical feature of the contracture is removed, adequate evaluation of the status of the anterior tibial muscle cannot be accomplished, nor can necessary reeducation and remedial exercises be effectively carried on. The longer the persistence of the gastrocnemius shortening, the greater the progress through the cycle (spasm — contracture — deformity) and the worse the prognosis for regaining a functional antagonist, whether the difficulty is weakness per se or alientation.

2. *Hamstring Contractures.* — In some degree, this was the commonest of all contractures, undoubtedly owing to the great incidence of hamstring

Fig. 1. — Gastrocnemius contracture with foot drop

Fig. 2. — Bilateral pectoral contractures

spasm in the acute stage of the disease. At the same time, it is the most amenable to correction. One author has stated that hamstring spasm occurs in every case of poliomyelitis as a manifestation of lower meningeal irritation and that it disappears spontaneously in every case in eight to ten days.[3n] In my experience hamstring spasm will always leave hamstring shortening unless adequate measures for restoring normal length are instituted.

3. *Pectoral Contracture* (Fig. 2). — Neglected pectoral shortening is among the most resistant deformities to correct. It is frequently associated with motor weakness of the deltoid muscle (in 14 of 16 cases here, the two

Fig. 3. — Quadriceps contracture

were concurrent) which undoubtedly in neglected cases contributes orthostatically to production of the contracture through a disuse immobilization factor. Early, intensive treatment of pectoral spasm will readily prevent contracture deformity.

4. *Quadriceps Contracture* (Fig. 3). — Quadriceps shortening or contracture is productive of: (*a*) if unilateral, a homolateral forward tilt of the pelvis with apparent lengthening of the leg and consequent derangement of

Fig. 4. — Plantar fascia contracture

Fig. 5. — Back tightness with slight total thoracolumbar scoliosis

Fig. 7. — Bilateral external rotational contractures of the hips

Fig. 6. — Kyphosis, lordosis and pelvic rotation

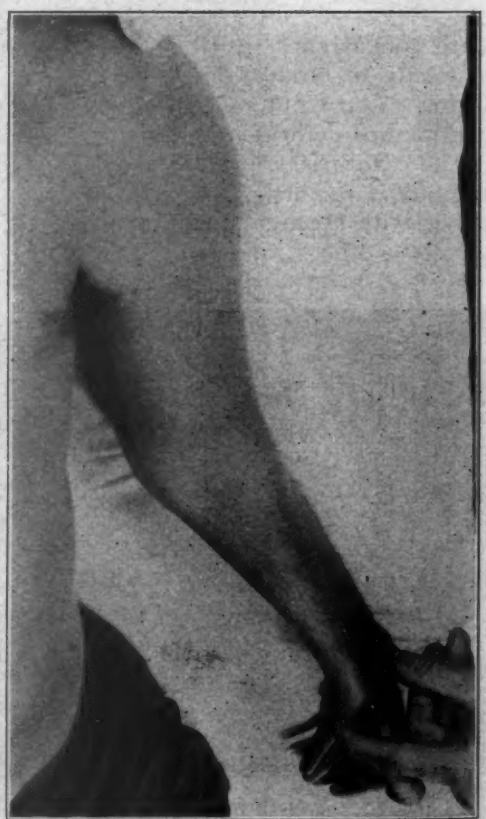

Fig. 8 — Marked pronator contracture of the forearm

the pelvis with increased lumbar lordosis, compensatory dorsal kyphosis and consequent postural and gait mechanical derangement.

5. *Plantar Fascia Contracture* (Fig. 4). — Plantar contractures are usually consequent to and parcel with uncorrected gastrocnemius tightness and its secondary mechanical foot drop.

6. *Tightness of the Back With or Without Scoliosis* (Figs. 5 and 6). — The degree of tightness of the back unilateral or bilateral (including tightness of the ilio psoas and quadratus muscles) is directly proportional to the extent of unreleased muscle spasm and resultant muscle shortening. The site and degree of consequent derangement (scoliosis, lordosis, kyphosis, etc.) is dependent, in addition, upon the location of the shortening and thus may present itself in a multiplicity of forms. With the exception of hamstring contractures, tightness of the back is the commonest source of deformity. To a large extent these are conditioned, aside from spasm, by poor bed posture, by muscle weakness, and/or by negligent attention to remedial exercise and to postural supervision in the convalescent patient.

7. *External Rotational Contractures of the Hips* (Fig. 7). — Rotational contractures of the hips are the consequence of faulty position in bed in which the use of foot boards, sandbags or pillows for the maintenance of neutral hip position has been neglected.

8. *Pronator Contractures of the Forearm* (Fig. 8). — Pronator contractures of the forearm are the result of immobilization with or without splinting and without attention in the acute stage to maintenance of normal range through the use of packing and stretching. They are not uncommonly encountered in cases with extensive arm involvement in which packing, stretching and muscle reeducation have been neglected and prolonged "across chest" or neck sling immobilization permitted.

Summary

1. Unreleased muscle spasm in poliomyelitis is the corner stone of the cycle (spasm — shortening — contracture — deformity) which is productive of deformities.

2. Interruption of the cycle with prevention of deformity is directly dependent upon not only good physical therapy but early physical therapy, the value of such being in inverse proportion to the time lapse prior to the institution of therapy.

3. Deformities in poliomyelitis constitute an indictment of the adequacy of the therapy administered.

4. In the management of 88 cases of poliomyelitis among Navy and Marine service personnel the incidence of deformities has been in accordance with these observations.

NOTICE TO CONGRESS MEMBERS

Please take notice that at the last annual business meeting of the Congress, Sept. 3, 1946, in New York City, the following proposed amendments to the Constitution and By-Laws of the Congress were read and then presented in writing to the meeting:

1. Amend Article VIII, Section 1 of the Constitution of the Congress to read as follows:

> "Section 1. Relation to the Organization. This organization shall operate a Registry for the purpose of maintaining a list of physical therapy technicians competent and qualified to administer adequate physical therapy under the prescription, direction and specific supervision of licensed physicians.
>
> "All matters pertaining to the functioning of the Registry shall be managed by a Board of Registry which shall be composed of seven members, to be appointed by the President of the Congress and confirmed by the voting members of the Congress. Only such members of the Congress as are in good standing in the Congress and practice physical medicine exclusively shall be eligible for appointment to and continuanee on the Board of Registry. Each member shall serve a term of seven years, so arranged that the ultimate objective shall be one appointment and confirmation annually. If before the expiration of the term for each was elected, a member of the Board dies, is removed or becomes disqualified, the President of the Congress shall designate a qualified person to serve the unexpired portion of the term."

2. Amend Article VIII, Section 2 of the Constitution to read as follows:

> "Section 2. The Board of Registry shall meet at least once annually and at such time or times as it may be called to meet by the written request of three members of the Board provided that the Registrar shall serve written notice on all members of the Board at least thirty days prior to the special meeting or meetings so requested."

A motion was then made, seconded and carried that, in accordance with the provisions of Article XVI of the Constitution and Chapter VII of the By-Laws the proposed amendments be made of record and that a copy thereof be sent by mail to each member not less than one month prior to the next annual business meeting together with notice that the matter would then be voted on for adoption or rejection.

This is to serve as notice to the members of the aforesaid action at the last annual meeting and as notice that at the forthcoming annual business meeting of the Congress to be held at 8:00 P. M., Sept. 2, 1947, at the Hotel Radisson, Minneapolis, the proposed amendments set out above will be voted on for adoption or rejection.

WESTERN SECTIONAL MEETING AMERICAN CONGRESS OF PHYSICAL MEDICINE

The 1947 meeting of the Western Section of the Congress will be held in San Francisco, July 12. Details as to place, program and time schedule were not available as this issue of the ARCHIVES went to press. They may, however, be obtained from the officers:

Theodore Stonehill, M.D.,
Chairman,
10730 W. Olympic Blvd.,
Los Angeles 25, Calif.

Arthur C. Jones, M.D.,
Secretary,
Medical Arts Bldg.,
Portland, Oregon.

ARCHIVES of PHYSICAL MEDICINE
OFFICIAL PUBLICATION AMERICAN CONGRESS OF PHYSICAL MEDICINE

.·. EDITORIALS .·.

MUSCULAR ACTIVITY

Recent developments in the field of physical medicine emphasize the importance of muscular activity in the prevention and treatment of disease and in the convalescent management. The early postoperative ambulation of surgical patients, early mobilization in fracture care, the employment of exercise in the treatment of chest injuries and certain chest diseases and the heavy resistance exercises of De Lorme all illustrate this point. Muscular activity is a potent stimulator of many physiologic processes and herein lies its value as a therapeutic agent.

The physiologic effects of exercise vary greatly with the dosage. Vigorous exercise in the healthy individual causes a marked increase in the rate of the heart beat and in the stroke volume. According to Best and Taylor,[1] the normal cardiac output ranges from 3 to 4.6 liters per minute, but with strenuous exercise it increases to 19 to 37 liters. The general circulatory rate may increase 10 fold while that of muscle may be augmented 20 fold. These changes are accompanied by a rise in blood pressure which may reach 200 mm. Hg systolic and 110 mm. diastolic. On the other hand, with light exercise, these circulatory changes are minimal.

Strenuous exercise causes a rise in the general bodily temperature of 1 to 4 F. This is associated with a corresponding increase in the metabolic rate. Ordinary activities such as walking and housework produce a metabolic increase of 100 per cent or more above the basal level, while hard labor may increase it more than 10 fold. The oxygen demand in severe exercise is great and is not met during the period of maximum exertion. A sprinter who runs the 100 yard dash in 10 seconds requires 6 liters of oxygen for the effort. The maximum rate of consumption is 4 liters per minute and he therefore creates an oxygen debt which may take an hour or more to repay. With light exercise, however, no oxygen debt is created.

Since oxygen is necessary for the reconversion of lactic acid to glycogen, there is, with strenuous exercise, an accumulation of lactic acid in the muscles and in the general circulation. With severe exertion, lactic acid may be produced at the rate of 3 Gr. per second and the blood level may rise to 0.2 per cent. It acts as a powerful stimulant of the respiratory center. Here again, however, there is marked variation with the degree of exertion.

It is apparent from the foregoing, that we are in need of a method of dosing exercise to fit the needs of the individual patient. This has been pointed out by Keys,[2] who indicated the common errors in the exercise prescription to be: 1, Lack of precise instructions; 2, failure to observe the effects of the exercise on the patient; 3, insufficient dosage of exercise; 4, failure to make exercise enjoyable and diverting; 5, failure to graduate exercise in close accord with the patient's condition.

An effort in the direction of the more accurate dosage in exercise therapy

1. Best, C. H., and Taylor, N. B.: Physiological Basis of Medical Practice, Baltimore, Williams and Wilkins Company, 1945, p. 225.
2. Keys, A.: The Physiology of Exercise in Relation to Physical Medicine, Arch. Phys Med. 26: 633, 1945.

has been made by Weiss and Karpovich[3] and is described in this issue of the ARCHIVES. They have measured the oxygen consumption or "energy cost" for forty-two common exercises and have arranged them in the order of increasing severity. By using this "cost list," the patient's daily program can be outlined with considerable dosage accuracy. The authors do admit, however, that the energy cost for the same exercise varies somewhat from patient to patient. Nevertheless, this work appears to be an important contribution in the direction of a more accurate exercise prescription.

3. Weiss, R. A., and Karpovich, P. V.: Energy Cost of Exercises for Convalescents, Arch. Phys. Med. 28:447, 1947.

MUSCLE ACTION AND TISSUE REPAIR

According to Sir Morton Smart,[1] in this issue of the ARCHIVES, one of the most serious features of injury to musculo-osseos structures is the accompanying atonicity and atrophy of muscles. Such muscles have lost much of their irritability, elasticity and contractility. The stretch reflex and the reciprocal activity are impaired and coordinated movements are difficult or impossible. Joints operated by atonic atrophic muscles are at a great disadvantage and the soft tissues of the joint are likely to be damaged.

He maintains that voluntary exercise alone is not sufficient to restore atonic wasted muscles to their "pristine" functional state. Muscle tone is restored, however, by correct electrical muscle stimulation. In addition to the restoration of tone, electrical stimulation increases the blood flow through the muscle and prevents adhesions formed by the organization of exudates within the injured tissues. For the best results from electrical muscle stimulation, treatment must be started at the earliest possible moment.

Although the author does not specify in his article what current he prefers for muscle stimulation in posttraumatic atonicity and atrophy, it is safe to assume that he uses his own special faradic apparatus, which has been described by him and others. This is a portable faradic coil in which the secondary current can be varied at will by means of a sliding soft-iron core-piece. It has been used extensively both in this country and England in the treatment of muscle atrophy and weakness not associated with interruption of the motor nerve supply.

1. Smart, M.: The Influence of Muscle Action on Tissue Repair, Arch. Phys. Med. 28:429, 1947.

THE TWENTY-FIFTH ANNUAL SESSION

After reviewing the program which has been prepared for the twenty-fifth annual session which convenes at the Hotel Radisson, Minneapolis, Sept. 2 to 6, 1947, and which you will find in this issue of the ARCHIVES, you will agree that your program committee has spared no effort to assemble an outstanding program. You will find it well balanced from the standpoint of subject matter which covers the various phases of physical medicine. Outstanding features of the program will be the round table discussion on biophysics arranged for the morning of Friday, Sept. 5, and the symposium on poliomyelitis for which the entire afternoon of Friday, Sept. 5, has been set aside. The scientific sessions are grouped to be presented at two simultaneous periods the mornings of Wednesday, Thursday, Friday, and with a single session for the afternoon of Wednesday, Thursday, Friday and the morning of Saturday. The papers will be limited in most instances to fifteen minute presentations. The morning scientific sessions will open at 10:30 a. m. except for Saturday, when the session will open at 9 a. m. The afternoon sessions will open at 2 p. m., thus permitting intermission periods for visits to the fine array of technical exhibits to be shown. Wednesday

evening will be devoted to the official opening, and outstanding speakers have been invited to take part. Thursday evening is set aside for the annual banquet, the only social function of the week. On Tuesday evening, Sept. 2, there will be the annual dinner for the executives of the Congress, followed by the first business session at 8 p. m. Saturday, Sept. 6, the Baruch fellows will gather for luncheon and their annual meeting. For Saturday afternoon the Minneapolis committee is arranging interesting and worthwhile tours to the many well known medical institutions located in the area.

A limited number of scientific exhibits have been accepted which you will find educational and inspiring.

The Educational Committee has spent much time in arranging two important features of the session. Tuesday morning, Sept. 2, will be devoted to an educational conference for physicians and Tuesday afternoon will be devoted to a continuation of the same educational conference to be participated in by the physicians and the technical directors of education in the field.

The annual instruction course has been prepared by the Educational Committee. This year the time schedule is different from that of former years. Complete detail of the course will be found elsewhere in this issue.

The headquarters for the session will be the Hotel Radisson. You are urged to make your hotel reservations promptly by writing to Mr. F. I. Nattestad, stating time of arrival and departure. Other hotels within close distance are the Hotel Nicollet and The Curtis.

Transportation in and out of Minneapolis is of the best. Many of our members have already indicated their plans to set aside further time for vacation in what is known as one of the finest resort regions in the country. The great North Woods, famous for lakes and fishing, annually attract many visitors. You would do well to plan such a side trip for yourself and family.

We seriously invite your study of the program and hope you will make every effort to make our twenty-fifth session comparable with the important place physical medicine has taken in the medical profession at this our twenty-fifth milestone.

AMERICAN BOARD OF PHYSICAL MEDICINE

An American Board of Physical Medicine was officially organized during the Atlantic City Session of the American Medical Association. Full details will appear in a later issue of the ARCHIVES.

COMMITTEE REPORTS
AMERICAN CONGRESS OF PHYSICAL MEDICINE

Report of the Finance Committee

The report of our auditor which follows indicates that for the year ending December 31, 1946 the American Congress of Physical Medicine continued to operate on a sound financial basis.

The officers of the Congress are to be congratulated on the wise expenditure of our funds and the stable condition of our finances.

FRANK H. KRUSEN, M.D., Chairman.
FRANK H. EWERHARDT, M.D.
ROY W. FOUTS, M.D.

Report on Examination for Year Ended December 31, 1946

May 8, 1947.

American Congress of Physical Medicine,
30 North Michigan Avenue,
Chicago, Illinois.

Dear Sirs:

We have examined the balance sheet of the American Congress of Physical Medicine as of December 31, 1946, and the summary of net income and surplus for the year ended that date, have reviewed the accounting procedures of the Congress and, without making a detailed audit of the transactions, have examined or tested accounting records of the Congress and other supporting evidence by methods and to the extent we deemed appropriate, except as stated in the following paragraph.

In an organization of this size, it is not practicable to maintain the accounting staff and system which would be required to insure internal control as to sources of income. We tested the correctness of the income recorded on the books by reference to available supporting details, but we did not make the extended verification of the income accounts which would be required in order to certify to the correctness thereof without qualification.

The space, personnel, and facilities of the general office are also used by the American Registry of Physical Therapy Technicians, an affiliated organization. It has been the practice of the Congress to pay the general office expenses and to charge the Registry for a portion thereof, based, in general, on the activities of the two organizations. During the years ended December 31, 1946 and 1945, the Congress billed the Registry for prorated expenses in the amounts of $6,949.80 and $6,984.72, respectively.

Subject to the limitation as to verification of income, in our opinion, the accompanying balance sheet and summary of net income and surplus fairly present, in conformity with generally accepted accounting principles applied on a basis consistent with that of the preceding year, the financial position of the American Congress of Physical Medicine at December 31, 1946, and the results of its operations for the year ended that date.

We submit the following exhibits:

Exhibit —

A — Balance Sheet, December 31, 1946.

B — Summary of Net Income and Surplus for the Year Ended December 31, 1946.

Yours truly,
GEORGE ROSSETTER & Co.

Exhibit A

American Congress of Physical Medicine
(Incorporated in Illinois — Not for Profit)
Balance Sheet, December 31, 1946

Assets

Current Assets:		
Cash in bank and on hand		$ 5,909.62
Accounts receivable:		
Advertisers and exhibitors	$ 645.25	
Members' dues	118.00	
American Registry of Physical Therapy Technicians	1,332,79	
Society of Physical Medicine	51.65	
Total	$2,147.69	
Less reserve for doubtful accounts	200.00	1,947.69
Investments in United States Savings bonds, Series G — at cost		15,000.00
Accrued interest		104.16
Sundry		7.06
Total		$22,968.53

Liabilities

Current Liabilities:		
Accounts payable:		
Trade	$ 764.60	
New York Society of Physical Medicine	50.00	$ 814.60
Employees' income tax withheld		380.63
Deposit		4.09
Total current liabilities		$ 1,199.32

Deferred Income:		
Subscriptions to "Archives" — unexpired portion	$4,717.07	
Dues collected in advance — year 1947	338.00	
Total deferred income		5,055.07
Surplus, per Exhibit B		16,714.14
Total		$22,968.53

Exhibit B

Summary of Net Income and Surplus for the Year Ended December 31, 1946

Income:		
Members' dues		$ 4,031.50
"Archives":		
Advertising	$5,674.02	
Subscriptions	7,914.18	
Sale of cuts, etc.	320.39	13,908.59
Interest on government securities		270.84
Convention income:		
Exhibits	$3,925.00	
Special instruction course	1,687.00	
Total	$5,612.00	
Direct convention expenses	4,079.54	
Convention income — net		1,532.46
Miscellaneous		19.85
Total income		$19,763.24
Expenses:		
Office expenses and salaries	$13,140.62	
Printing expense — "Archives"	7,917.53	
Cuts, half-tones, electros, etc.	1,079.10	
Special meetings	150.00	
Bank exchange	13.53	
Professional fees	521.10	
Loss on doubtful accounts	132.75	
Traveling	62.98	
Cash discount on advertising	244.64	
Miscellaneous	159.97	
Share of office expense billed to:		
Society of Physical Medicine (credit*)	120.00*	
American Registry of Physical Therapy Technicians (credit*)	6,949.80*	
Total expenses (net)		16,352.42
Net income for the year		$ 3,410.82
Surplus at beginning of the year		13,303.32
Surplus at end of the year		$16,714.14

Report on Examination for Year Ended December 31, 1946

May 9, 1947.

American Registry of Physical Therapy Technicians,
30 North Michigan Avenue,
Chicago, Illinois.

Dear Sirs:

We have examined the balance sheet of the American Registry of Physical Therapy Technicians as of December 31, 1946, and the statement of net income and surplus for the year ended that date, have reviewed the accounting procedures of the Registry and, without making a detailed audit of the transactions, have examined or tested accounting records of the Registry and other supporting evidence by methods and to the extent we deemed appropriate, except as stated in the following paragraph.

In an organization of this size it is not practicable to maintain the accounting staff which would be required to insure internal control as to sources of income. We tested the correctness of the income recorded on the books by reference to available supporting details, but we did not make the extended verification of the income accounts which would be required in order to certify to the correctness thereof without qualification.

The space, personnel, and facilities of the general office of the American Congress of Physical Medicine, an affiliated organization, are used by the American Registry of Physical Therapy Technicians. It is the practice of the Congress to pay the general office expenses and to charge the Registry for a portion thereof, based, in general, on the activities of the two organizations. During the years ended December 31, 1946 and 1945, the Congress billed the Registry for prorated expenses in the amounts of $6,949.80 and $6,984.72, respectively.

Subject to the limitation as to verification of income, in our opinion, the accompanying balance sheet and statement of net income and surplus fairly present, in conformity with generally accepted accounting principles applied on a basis consistent with that of the preceding year, the financial position of the American Registry of Physical Therapy Technicians at December 31, 1946, and the results of its operations for the year ended that date.

We submit the following exhibits:
Exhibit —
A — Balance Sheet, December 31, 1946.
B — Statement of Net Income and Surplus for the Year Ended December 31, 1946.

Yours truly,
GEORGE ROSSETTER & CO.

Exhibit A

American Registry of Physical Therapy Technicians
(Incorporated in Illinois — Not for Profit)
Balance Sheet, December 31, 1946

Assets

Current Assets:		
Cash on deposit	$5,427.04	
Accounts receivable — dues.	338.00	
Investments in United States Savings bonds, Series G — at cost	11,500.00	
Accrued interest	79.15	
Total		$17,344.19

Liabilities

Current Liabilities:		
Account payable — American Congress of Physical Medicine	$1,332.79	
Student deposits on Registry pins	151.20	
Accrued federal excise tax..	39.00	
Sundry	7.00	
Total current liabilities		$ 1,529.99
Deferred Income:		
Dues collected in advance—year 1947	$4,208.00	
Deposits with applications (subject to refund if applications are rejected)....	40.00	
Total deferred income.		4,248.00
Surplus, per Exhibit B		11,566.20
Total		$17,344.19

Exhibit B

American Registry of Physical Therapy Technicians

Statement of Net Income and Surplus

For the Year Ended December 31, 1946

Income:		
Dues	$4,916.00	
Registration fees	6,494.00	
Sales:		
Pins	1,500.30	
Emblems	331.00	
Directory	82.70	
Interest on United States bonds	268.83	
Miscellaneous	3.25	
Total income		$13,596.08
Expenses:		
Offices expenses & salaries..	$6,949.80	
Printing and multigraphing	753.07	
Exchange	29.92	
Examinations — supervision and grading	276.47	
Loss on bad debts	8.00	
Professional fees	399.50	
Purchase of emblems	148.74	
Purchase of pins	1,248.91	
Bond premium	25.00	
Directory	896.16	
Traveling	230.80	
Miscellaneous	104.87	
Total expenses		11,071.24
Net income for the year		$ 2,524.84
Surplus at beginning of the year		9,041.36
Surplus at end of the year		$11,566.20

Report of Committee for Cooperation With Army, Navy, Public Health and Veterans Administration

No problems have been referred to this committee. Should there be any new developments these will be reported at the Minneapolis session.

O. LEONARD HUDDLESTON, M.D., Chairman.

DONALD A. COVALT, M.D.
COMDR. HARRY S. ETTER, (MC), U. S. N. R.
GEORGE G. DEAVER, M.D.
DEAN M. HAYES, M.D.
LIEUT. COL. BENJAMIN A. STRICKLAND, JR., (MC), U. S. A.

Committee on Cooperation With the Food and Drug Administration

On February 28th, 1947, Dr. I. Levin, as chairman, Lieut. Col. Ben. Strickland, Comdr. Harry S. Etter, Dr. Frances Hellebrandt and Dr. Wayne McFarland representing the American Congress of Physical Medicine met with Drs. Norman DeNosaquo and R. T. Stormont who represented the Food and Drug Administration.

Dr. DeNosquo gave an explanation of the provisions of the act as they applied to physical therapy devices which are shipped in interstate commerce and which might be misbranded.

A discussion was held as to the relation of this committee with the Council on Physical Medicine of the American Medical Association.

Dr. DeNosaquo explained that there would be no conflict with the Council on Physical Medicine because this committee would help the Food and Drug Administration in determining in the light of scientific information in the field of physical medicine when devices were misbranded from what laymen would imply from the labeling whereas the Council on Physical Medicine was concerned primarily with devices going to practitioners.

A discussion was held as to how this committee would be utilized by the Food and Drug Administration. It was indicated that the committee could be of help in the following ways:

(1) To obtain expert opinion concerning the field of usefulness of the device under consideration;

(2) To help in any testing that may be necessary; and

(3) To obtain their services as experts to testify in court.

The committee hopes to have more meetings in the near future.

ISADORE LEVIN, M.D., Chairman.

WILLIAM BIERMAN, M.D.
COMDR. HARRY ETTER, (MC), U. S. N. R.
FRANCES HELLEBRANDT, M.D.
O. LEONARD HUDDLESTON, M.D.
H. WORLEY KENDELL, M.D.
WAYNE MCFARLAND, M.D.
LIEUT. COL. BENJAMIN A. STRICKLAND, JR., (MC), U. S. A.

Report of Committee to Foster and Encourage Research Projects

The "committee to foster and encourage research" has had no work referred to it. The suggestion is made, however, that the Congress consider setting aside money to grant an annual award to the individual or group responsible for what in the opinion of the committee is the best piece of research in our field reported during the preceding year.

ARTHUR L. WATKINS, M.D., Chairman.

WILLIAM BIERMAN, M.D. MILAND E. KNAPP, M.D.
O. LEONARD HUDDLESTON, M.D. GEORGE MORRIS PIERSOL, M.D.

Report of the Committee on Medical Economics

The committee has under consideration the following items:

1. Status of the Physiatrist in private institutions.
2. Hospitalization Association (Blue Cross, etc.) contracts including physical treatments as part of hospital service.
3. Departments of physical medicine in small hospitals and in smaller communities.
4. Occupation therapy—cost of maintenance.
5. The $2.00 fee for physical treatments by the Veterans Administration and Industrial Commission to private institutions and physicians.

Because these problems vary in different localities, an expression from the membership at the forthcoming meeting is desired.

WALTER M. SOLOMON, M.D., Chairman.
MADGE C. L. MCGUINNESS, M.D.
LOUIS B. NEWMAN, M.D.

Report of Committee on Meeting Place

The Committee on Meeting Place for 1948 reports that consideration has been given to various locations for the annual meeting. Because of the definite interest expressed last year, consideration was given to the possibility of holding the annual session on the west coast. It was the consensus of opinion that because of the great distance and lack of concentration of membership in this region, it would not be advisable to consider the west coast for 1948. Boston was given consideration, but on checking with the hotels it was found that the dates required for our meeting are already booked for next year. It seems the committee was favorable toward considering Washington, D. C., for 1948. Tentative hotel reservations have been made to await the official action of the Congress in September.

The Meeting Place Committee will again review the whole question before the business meeting in September, at which time the members can make further suggestions and recommendations relative to the annual session in 1948.

WALTER J. ZEITER, M.D., Chairman.

FRANCES BAKER, M.D. ARTHUR L. WATKINS, M.D.
DONALD ERICKSON, M.D.
EMIL J. C. HILDENBRAND, M.D.

Report of the Membership Committee

The Committee on Membership again reports with satisfaction a steady increase in the number of new members from all parts of the United States and abroad. At the meeting of the Congress, Sept., 1946, forty-nine applicants were elected to membership, with the following geographic distribution: New York, 13; Pennsylvania, 6; District of Columbia and Virginia, 4 each; Illinois, Massachusetts and Ohio, 3 each; Connecticut and Texas, 2 each; Arkansas, California, Michigan, Minnesota, Oregon and Tennessee, 1 each; abroad, Canada, 2 and Australia, 1.

The membership census on May 1, 1947 showed a total membership was 512, geographically distributed as follows:

State	Number of Members	State	Number of Members
Alabama	2	Nevada	1
Arkansas	3	New Jersey	17
Arizona	1	New York	123
California	22	North Carolina	4
Colorado	4	Ohio	34
Connecticut	8	Oklahoma	4
District of Columbia	19	Oregon	3
Florida	8	Pennsylvania	60
Georgia	4	Rhode Island	2
Illinois	30	Tennessee	4
Indiana	12	Texas	10
Iowa	9	Utah	3
Kansas	4	Vermont	1
Kentucky	3	Virginia	8
Louisiana	3	Washington	3
Maine	1	West Virginia	3
Maryland	6	Wisconsin	13
Massachusetts	10		
Michigan	10	Abroad	
Minnesota	11	Canada	16
Missouri	3	Other	14
Nebraska	4	Address Unknown	3

Membership outside of the United States, totaling 30 was distributed as follows: Canada, 16; Australia, England, Mexico and Portugal, 2 each; Belgium, Brazil, Denmark, Puerto Rico, Uruguay and Venezuela, 1 each.

At the time of rendering this report the number of new applications pending was 53.

RICHARD KOVACS, M.D., Chairman.
CHARLES R. BROOKE, M.D. NICHOLAS MAURIELLO, M.D.
CLARENCE W. DAIL, M.D. COL. ARTHUR WHITE, (MC), U. S. A.

Report of Committee on Problems Affecting Physical and Occupational Therapists

The only problem presented to this committee since it was appointed, deals with the status of physical therapists in the employ of the Veterans Administration.

It appears that graduate registered physical therapists must take civil service examinations in order to qualify for employment by the Veterans Administration, while the same is not required of dietitians and nurses. Regarding this as discrimination, certain physical therapists in one of the Veterans Administration hospitals have written their civil service examinations under protest and have notified the American Registry of Physical Therapy Technicians that such action has been taken. The problem has recently been referred to this committee for study.

At the present time the committee is making a careful investigation of the matter and will be able to report more completely at a later date.

FRED B. MOOR, M.D., Chairman.
SHELBY GAMBLE, M.D. GORDON MARTIN, M.D.
FRANCES HELLEBRANDT, M.D. NATHAN POLMER, M.D.

Report American Registry Physical Therapy Technicians

Period Jan. 1 to Dec. 31, 1946

Number registrations completed	862
Number examinations conducted	671
Number of retake examinations conducted	38
Number barred from registration because of total failure	10
Number registrations cancelled	6
Number of failures, new within the period	26
As a comparison, during a similar period of 1945, 630 examinations were conducted with 40 failures.	
Number of requests for qualified personnel	240
Number of requests for positions	420
Number of placements completed	60

Certificates Issued According to School of Graduation

Name of School	Number of Graduates Registered
Ashford General Hospital, White Sulfur Springs, W. Va.	31
Barnes Hospital, St. Louis	12
Boston Univ. (Sargent College), Cambridge, Mass.	22
Bouve-Boston Sch. Phys. Ed., Boston	26
Brooke Gen. Hospital, San Antonio, Texas	35
Bushnell Gen. Hosp., Brigham City, Utah	24
Calif. Hosp., San Francisco	6
Children's Hosp., Los Angeles	43
Cleveland Clinic Foundation Hosp., Cleveland	18
Coll. Med. Evangelists, Los Angeles	10
Columbia Univ., New York City	30
Duke Hospital, Durham, N. C.	11
Fitzsimons Gen. Hosp., Denver, Colo.	49
Harvard Med. Sch., Boston	27
Hosp. for Special Surgery, New York City	9
State Univ. Iowa, Col. of Med., Iowa City, Ia.	23
Percy Jones Gen. Hosp., Battle Creek, Mich.	25
Univ. Kansas, Sch. of Med., Kansas City, Kan.	4
Lawson Gen. Hosp., Atlanta, Ga.	59
Mayo Clinic, Rochester, Minn.	71
Univ. Minn., Minneapolis	16
New York Univ., New York City	56
Northwestern Univ., Chicago	30
O'Reilly Gen. Hosp., Springfield, Mo.	32
Graduate Hosp., Univ. Pa., Phila.	2
Posse Sch., Boston	3
Walter Reed Gen. Hosp., Washington, D. C.	55
Baruch Center of Phys. Med., Richmond Professional Inst., Richmond, Va.	19
Stanford Univ., Stanford Univ., Calif.	59
St. Louis Univ. Sch. of Nursing, St. Louis, Mo.	1
Univ. Texas Sch. Med., Galveston, Texas	6
D. T. Watson Sch. Physiotherapy, Leetsdale, Pa.	27
Univ. Wis. Med. Sch., Madison, Wis.	21
Total	862

Report of the Committee on Public Relations

The only matter to come to the committee's attention since our last report has been the subject of allocation of wavelengths by the Federal Communications Commission on December 19, 1946. A hearing and oral argument were held in Washington, D. C., and the meeting was attended by the chairman of this committee. At this time the advisability of allocating a wider band of frequencies in the 27 megacycle region of the spectrum was urged. This wavelength includes the medical diathermy and industrial heating equipment and the meeting was widely attended by representatives of industry. In a communication dated April 10, 1947, the commission listed as follows:

"The commission also having under consideration its recommendation dated February 18, 1947, to the Department of State, for approval at the forthcoming conference of the International Telecommunications Union that the frequency band 27.160-27.480 megacycles be made available for industrial, scientific, and medical uses and to the amateur, fixed, and mobile services, subject to interference from industrial, scientific or medical operation; and the fact that no objection from interested parties has been received by the commission to its recommendation which was made after full opportunity for the submission of such objection; and

"The commission also having under considera- public interest, convenience and necessity would be served by allocation for use in the United States by industrial, scientific and medical devices of the frequency band 27.160-27.480 Mc as set forth in the proposal referred to above, with certain provision for use of such frequencies by the amateur, fixed and mobile services; and

The commission having further determined that under the circumstances set forth above the said amendments should become effective immediately:

Now, Therefore, It is Hereby Ordered, that the frequency allocation plan set out below for

the frequency band 27.160-27.480 megacycles, Be, and the Same Is Hereby, Adopted, effective immediately to supersede any plan heretofore adopted for the said frequency band or any portion thereof:"

It will be seen from this report that the wavelength has been increased 25 megacycles both in the lower and higher frequencies. This widening of the wavelength will permit the production of apparatus limited to these wavelengths without having to use crystal control. This, of course, will help to keep the apparatus in a reasonable price field as well as simplifying the service. Of course, it must also be realized that even operation within this band that interfere with communication will be subject to examination and possible prohibition of apparatus producing the interference.

The commission has further set aside a frequency of 2450 megacycles for experimental use with microwaves. The commission has received testimony and information from representatives of this service substantiating a need for additional frequencies at approximately 3, 6, 500, 1000, 10000, and 15000 megacyles. To satisfy this requirement, the commission proposes to allocate the frequencies listed. However, before this is done, further arguments will be received in the form of written statements which must be submitted by April 30 by any who are opposed. The commission will then decide whether a further hearing or an oral argument will be necessary.

If the commission acts on this, following any oral arguments, it will result in a complete band of frequencies for the industrial, scientific, medical service as follows:

6 Mc ± 2.5 kc (specific frequency to be announced later)	
13.66 Mc ± 7.5 kc	2450 Mc ± 50 Mc
27.32 Mc ± 160 kc	5850 Mc ± 75 Mc
40.98 Mc ± 20 kc	10600 Mc ± 100 Mc
915 Mc ± 25 Mc	18000 Mc ± 150 Mc

WILLIAM H. SCHMIDT, M.D., Chairman.
HOWARD RUSK, M.D.
ROBERT L. STECHER, M.D.

MEDICAL NEWS

The New Surgeon General and the Deputy Surgeon General

President Truman on April 23 sent to the Senate for confirmation the nomination of Brig. Gen. Raymond W. Bliss as Surgeon General of the Army to succeed Major Gen. Norman T. Kirk, whose term expired May 31. Also forwarded to the Senate for confirmation was the nomination of Col. George E. Armstrong, M.D., as Deputy Surgeon General with the rank of brigadier general for a four year term.

Symposium at Army Medical Center

The Surgeon General, Major Gen. Norman T. Kirk sent out invitations for a symposium which was held at the Walter Reed General Hospital, Army Medical Center, Washington, D. C., June 3-5. Among the subjects discussed were: "What Physical Medicine Has to Offer the Medical and Surgical Practitioner," by Dr. Frank H. Krusen, head of the Section on Physical Medicine, Mayo Clinic, Rochester, Minn.

Congress Members Take New Posts

Dr. H. Worley Kendell, president-elect of the American Congress of Physical Medicine, has assumed his duties as director of the department of physical medicine, University of Illinois College of Medicine, Chicago.

Dr. Gordon Martin has joined the section on Physical Medicine of the Mayo Clinic.

Dr. Donald Rose is the medical director of the course in physical therapy at Kansas University and also director of physical medicine, University Hospitals, Kansas City, Kan.

Dr. Northway Promoted

Dr. William H. Northway has been promoted to the rank of associate professor of medicine, Stanford University School of Medicine.

Dr. Bouman to Wisconsin

Dr. Henry D. Bouman has been appointed associate professor and head of the department of physical medicine, University of Wisconsin Medical School. He becomes the new medical director of the course for training in physical therapy.

Physical Therapists and Nurses Needed

With the enactment of Public Law 36, 80th Congress which grants permanent commissioned status to members of the Army and Navy Corps and establishes a Women's Medical Specialist Corps in the Regular Army, about 1,800 vacancies exist in the Army Nurse Corps of the Regular Army.

The Women's Medical Specialist Corps will be composed of the Physical Therapist Section, Occupational Therapist Section and Dietitians Section. The law provides for a chief of the Women's Medical Specialist Corps in the tem-

porary grade of colonel and an assistant chief for each section in the temporary grade of lieutenant colonel.

Qualified physical and occupational therapists for whom no vacancy is available in the Regular Army will be offered a commission in the Reserve Corps which is created by this legislation. Application blanks may be obtained at the six army headquarters, all general hospitals within the continental limits of the United States and on request from the Surgeon General's Office, Washington, D. C.

Veterans Administration News

The Occupational Therapy Department of the Veterans Administration hospital at Batavia, N. Y., adapted three foot and hand looms for blind veteran-patients by "writing" patterns on Braille boards. When the patient moves a wooden peg opposite a board's pattern lines, he can weave without assistance.

Residencies in physical medicine approved by the American Medical Association have been or are being established in VA hospitals in Richmond, Va.; Minneapolis, Minn.; Denver, Colo.; New Orleans, La.; Los Angeles, Cal. and Portland, Ore.

The VA hospital at Framingham, Mass., instituted a series of 21 lectures sponsored by the Educational Retraining, Medical Rehabilitation Service on small businesses for paraplegic veteran-patients who plan to go into business when they are discharged from the hospital.

Physical therapists are employed in 125 of the 126 VA hospitals, as well as in 20 VA regional offices.

Twenty-eight outstanding authorities in physical medicine and medical rehabilitation are serving as consultants to Veterans Administration. Among them are Dr. Howard A. Rusk, New York University; Dr. Frank H. Krusen, Mayo Clinic; Dr. George G. Deaver, Institute for the Crippled and Disabled, New York City, and Mr. Kjell Peterson, Metropolitan Life Insurance Co.

A total of 458,749 veteran-patients were admitted to Veterans Administration and non-Veterans Administration hospitals during the calendar year 1946, the Veterans Administration reports. General medical and surgical patients accounted for 83.19 per cent of the admission, and neuropsychiatric patients for 11.77 per cent of the total. The smallest group, 4.27 per cent of the total, was the tuberculous patients.

Medical Research

State legislation against dog stealing passed in recent weeks in Massachusetts and New York and pending in California, Maryland, Wisconsin, Pennsylvania, and Michigan has been labeled a propaganda trick of the antivivisection cult by Dr. Anton J. Carlson, President of the National Society for Medical Research.

"For more than 100 years it has been illegal in most parts of the western world to steal dogs," said Dr. Carlson. "This new legislation adds nothing to the protection afforded pet owners by existing laws. The only reason for the introduction of these bills has been to provide a springboard for fantastic charges by the antivivisectionists against medical and veterinary institutions.

"It seems impossible," said Dr. Carlson, "that any one could believe that universities, state and city health departments, and great hospitals would sponsor thievery. Yet," Dr. Carlson observed, "it seems that some people will believe even the most ridiculous things if they see them in print."

Dr. Carlson suggested that the best way to protect pets would be to centralize all responsibility for the administration of laws pertaining to animals in a single government agency such as the police department. "Then," said Dr. Carlson, "the pet owner would always know where to turn for help in locating a lost animal.

"From the standpoint of medical research the advantage would lie in eliminating the confusion which makes antivivisection slanders possible," said Dr. Carlson.

The National Research Council has announced the initial five awards under a $100,000 fund established by Merck & Co., Inc., to provide promising young scientists with further research training in the closely allied fields of chemistry and biology.

Many scientific problems are so complex that combinations of skills are needed, and the purpose is to help foster the development of scientific leaders with broad competence in the natural sciences. The selections, made by the Council's Merck Fellowship Board and announced in the magazine "Science," are:

Joseph Lein of New York City, for advanced study at the California Institute of Technology on the specificity of enzymes produced by mutated and non-mutated genes in Neurospora;

Nevin Stewart Scrimshaw of Rochester, for a biochemical study at the University of Rochester of factors associated with toxic complications of pregnancy and fetal abnormalities;

Lorin John Mullins of Palo Alto, Cal., for advanced work at the Naples (Italy) Zoological Station on the experimental modification of permeability phenomena in marine vertebrates and invertebrates;

Arthur Beck Pardee of Pasadena, Cal., for researches at the University of Wisconsin in general physiology, histology, cytology and related fields as preparation for a career in medical research; and

B. Roger Ray of Nampa, Idaho, for work at the Rockefeller Institute for Medical Research, New York City, on the determination of movements of salts through certain nonaqueous solutions by means of high speed centrifugation, the results of which will apply to the problem of cell permeability.

These first Merck Fellowships are for the year 1947-1948. The recipients were selected from a field of forty-nine applicants. The amounts of the awards vary with the individual circumstances in each case.

The Merck Fellowship Board, which was appointed by the Council, consists of the following members:

Dr. A. N. Richards, University of Pennsylvania, chairman; Dr. George W. Beadle, California Institute of Technology; Dr. Hans T. Clarke, Columbia University; Dr. George O. Curme, Jr., Carbide and Carbon Chemicals Corporation; and Dr. Rene J. Dubos, Rockefeller Institute for Medical Research. Dr. Bronk also is a member, ex-officio.

Workshop on Problems of Supervision

During the last week of May, the Baruch Center of Physical Medicine conducted a 5-day workshop on problems of supervision. This was designed particularly to assist the Navy in establishing a sound program of clinical practice for students who have received nine months of didactic training in Physical Therapy at the Medical College of Virginia. The Symposium offered opportunity for a systematic review of recent advances in clinical Physical Medicine and its supporting basic sciences—medical physics, applied physiology and functional anatomy. Major emphasis was placed on the technic of job analysis, the principles of supervision and methods of rating performance. Attention was given to the responsibilities of the supervisor as a teacher and methods of expediting continuation education during the period of clinical practice.

The Proceedings of the Symposium on Supervision will be edited and issued in the form of a handbook on policies and procedures which may be used as a guide by hospitals affiliated with the Medical College of Virginia for extramural preceptorial teaching.

BOOK REVIEWS

TEXTBOOK OF PHYSIOLOGY. By *William D. ZOETHOUT,* Ph.D., Professor Emeritus of Physiology in the Chicago College of Dental Surgery (Loyola University) and *W. W. Tuttle,* Ph.D., Professor of Physiology, College of Medicine, State University of Iowa. Ninth edition. Fabrikoid. Price, $4.75. Pp. 723, with 304 text illustrations and 6 color plates. St. Louis: The C. V. Mosby Company, 1946.

In this edition more than half the text has been rewritten, especially chapters on respiration, metabolism and the nervous system. There are several new illustrations and three new color plates.

If the purpose of this text is still to supply a useful book to students in Dental, Pharmacy and Normal Schools who have a limited time to study physiology at their disposal, it succeeds admirably. It is highly readable and for the most part quite accurate and up to date. To some extent it is necessarily didactic, omitting controversies which would be quite out of place in such a work. References are appropriately few and general in nature.

The discussion of digestive enzymes and hormones is rather too brief and omits much recent knowledge. One could likewise cavil at the definition given of "effort syndrome." The presentation is qualitative-descriptive.

In the main the book is to be highly recommended for its announced purpose. The restful type and skillfully chosen illustrations add much to its value. A helpful glossary is appended for the nonmedical student.

SEGMENTAL NEURALGIA IN PAINFUL SYNDROMES. By *Bernard Judovich,* B.S., M.D., Instructor in Neurology, Graduate School of Medicine, University of Pennsylvania; Clinical Instructor in Neurology, Womans Medical College; Chief of Neuralgia Clinic, Graduate Hospital, Philadelphia, Pa., and *William Bates,* B.S., M.D., F.A.C.S., F.I.C.S., Professor of Surgery, Graduate School of Medicine, University of Pennsylvania; Consulting Surgeon, Babies' Hospital and Philadelphia Home for Incurables; Consulting General Surgeon, Wills Hospital, Philadelphia, Pa. With a foreword by *Joseph C. Yaskin,* M.D., Professor of Neurology, Graduate School of Medicine, University of Pennsylvania, Philadelphia, Pa. Second edition. Fabrikoid. Price, $5.00. Pp. 335, with 178 illustrations. Philadelphia: F. A. Davis Company, 1946.

In this edition, the authors again summarize their clinical experience and observations dealing with the syndrome of segmental neuralgia. An attempt is made "to develop and present a clinical concept of somatic pain which can be applied to the actual examination and treatment of patients." After listing the possible etiologic factors causing segmental pain, the authors describe in detail their method of physical examination for eliciting various types of tenderness and the pain distribution necessary for the differential diagnosis of this syndrome. The volume includes clinical and therapeutic information concerning brachial plexus pain and the scalenus anticus syndrome; abdominal scars and adhesions; sciatic nerve pain; and pain in malignancy. Chapters on posture in relation to abdominal pain, and the neuralgic aspects of low back pain are of particular interest to the physiatrist.

This edition again contains information concerning the authors' experience using local infiltration of the pitcher plant distillate and ammonium salts for relief of neuralgic pain. It is to be noted that they now believe the ammonium ion is the effective principle and the distillate is no longer necessary. A well illustrated chapter deals with the technic of local infiltration and nerve block in the most commonly involved segments, and will be of value to those interested in this procedure.

Although the authors are unable at present to present a more complete description of the etiology and pathogenesis of neuralgic pain, they have written a stimulating volume concerning the clinical differentiation and a practical therapeutic approach to segmental neuralgia.

THE PRESERVATION OF PROTEINS BY DRYING WITH SPECIAL REFERENCE TO THE PRODUCTION OF DRIED HUMAN SERUM AND PLASMA FOR TRANSFUSION. By *R. I. N. Greaves.* Special Report, Series No. 258, Medical Research Council. Paper. Pp. 98, including 20 plates. Price, 2s. Od. net. London: His Majesty's Stationery Office, 1946.

PHYSICAL MEDICINE ABSTRACTS

Occupational Therapy and Rehabilitation. A. N. Aitken.

Am. Rev. Tuberc. 55:49 (Jan.) 1947.

Basically a rehabilitation program in a sanatorium is a plan of treatment to counteract the psychosomatic effects of the disease, tuberculosis. It is unfortunate that the term "psychosomatic medicine" had not come into use before the catch-all word "rehabilitation" had become so widely adopted in medical and nonmedical fields. Or rather, if some word had been devised, specifically delineating the treatment of the psychosomatic effects of disease, much confusion and misunderstanding would have been avoided. This is particularly true in the treatment of tuberculosis.

Tuberculosis may produce a wide range of physical handicaps and the patients are subjected to a multitude of emotional disturbances, brought on by a complexity of causative factors, often due to popular misconceptions, false implications and prejudices, handed down through the generations. Many methods have been devised to correct or ameliorate these physical and mental handicaps.

These emotional disturbances begin with the diagnosis of the disease. It is consumption, a thing to be shunned, incurable or leading to a life of uselessness. They are augmented by hospitalization, separation from family and friends, the stigmata of welfare-aid so often needed and all those that go with being a sanatorium inmate. They are exaggerated by treatment, the necessary emphasis on the communicable nature of the disease and the invalidism which we deliberately develop. Patients become self-conscious, isolated and sensitive and dependent. They are neurotic, self-centered, selfish, fearful of others, fearful of themselves, fearful of effort. It becomes impressed in them that to keep on living is the only important thing in life. These are disabilities which can be counteracted only by well-timed measures, often devious and unobstrusive, and by constant effort.

Basically a rehabilitation program in a sanatorium is a plan of treatment to counteract the psychosomatic effects of the disease, tuberculosis. In such a program physical retraining, mental and social readjustment are essential and, as an adjuvant to these, vocational training is valuable. To achieve these results, a variety of facilities are available and many methods can be used. As occupational therapy is any activity prescribed and guided for the purpose of contributing to recovery, any of the methods used in such a program can be incorporated in this line of therapy. This type of program, as it is used at Niagara Sanatorium, is described. The results in reducing hazard to the public, by keeping patients satisfied with sanatorium care and by helping prevent post-sanatorium relapse, are presented.

Rehabilitation of the Tuberculous. The Program of a Municipal Sanatorium. I. D. Bobrowitz.

Am. Rev. Tuberc. 55:43 (Jan.) 1947.

A complete rehabilitation process involves not alone the period in the sanatorium, but also the time before admission and after discharge. The program is divided into three intimately related phases which are of equal importance, the pre-sanatorium, in-sanatorium and post-sanatorium periods.

From the time of diagnosis and thereafter, public and voluntary agencies, such as medical, welfare, social service and public health nursing, work with the patient and family and refer the patients to the sanatorium. These are known as the referring or active working agencies. Rehabilitation groups come into the picture during and after the sanatorium period. The functions, responsibilities and relationships ascribed to these organizations had been agreed upon after a series

of meetings attended by the sanatorium and the agencies.

Successful rehabilitation requires a comprehensive and effective sanatorium program and close cooperation between the sanatorium and the community. All of the community services must be integrated to serve the patient and family during all the phases of treatment, from the time of diagnosis until the individual is fully adjusted. Under these conditions patients will accept sanatorium care, remain till their tuberculosis is arrested and follow through with necessary rehabilitation plans.

The rehabilitation program we have outlined attempts, in a practical and efficient manner, "to restore the tuberculous to the fullest physical, mental, social, economic and vocational usefulness of which they are capable."

Kinesotherapy and Extension Treatment in Rheumatoid Arthritis. Gunnar Edstrom.

Brit. J. Phys. Med. 10:4 (Jan.-Feb.) 1947.

The aim in kinesotherapy for rheumatoid arthritis must be avoidance of all manipulations which are not necessary to preserve the function of the diseased joints. In spite of this, the therapeutic employment of movement is necessary in almost every case of rheumatoid arthritis, because in this disease the function of the affected joints invariably demands careful attention. In every case of rheumatoid arthritis it is necessary for the articular function to be regularly controlled from the outset of the disease by a trained medical gymnast. Unfortunately, this prophylactic measure against contractures is rarely adopted and a rheumatism clinic is daily visited by patients with contractures or defective positions in one or several joints.

It is evident that in the kinesotherapy of rheumatoid arthritis the principal emphasis is laid on remedial exercises. Massage, however, ought to be employed to a limited extent in rheumatoid arthritis. Only in cases of pronounced muscular atrophy, which are difficult to treat with movements, as in seriously affected cases confined to bed, or in order to facilitate the medical gymnastics by a softening of hard contracted muscles, can massage of the muscles and the tendons be used to some extent, although always with caution and a gentle hand. Massage should never be applied over the affected joints.

Visual Sensations Aroused by Magnetic Fields. Horace B. Barlow; Henry I. Kohn, and E. Goeffrey Walsh.

Am. J. Physiol. 148:372 (Feb. 1) 1947.

Visual sensations aroused by physical stimuli other than light are called phosphenes, and their production by the application of electric currents to the eye has long been known. Electromagnetic fields may also elicit phosphenes; a relatively obscure fact which d'Arsonval (1896) appears to have been the first to record. Thompson (1910) unaware of previous work, rediscovered this effect of magnetic fields using 1,000 Gauss at 50 c. p. s. and described the sensation as a colorless flicker which was brightest in the peripheral parts of the visual field. Dunlap (1911) and Magnusson and Stevens (1912) confirmed this description and made the additional observation that the 25 cycle field was more effective than the 60. For their work the author used alternating magnetic fields of variable frequency and compared the properties of the sensations thereby produced with those produced by passing sinusoidal electric currents through the head.

Ambulatory Electroconvulsive Therapy. Fred Feldman; Evelyn Gomber, and S. Eugene Barrera.

J. Nerv. & Ment. Dis. 105:171 (Feb.) 1947.

Although electroconvulsive therapy is usually administered in a hospital, and generally restricted to in-patients, the need for making this mode of treatment available to out-patients has been widely recognized. This need is fostered by a diversity of factors, economic, social, familial, personal and medical. Awareness of the problem has led to attempts at its practical solution in a number of ways, some of them feasible and others hazardous. At the Albany Hospital electroshock therapy has been utilized at the rate of 5,500 treatments annually, more than 3,000 of which are administered to out-patients on an ambulatory basis. It is the purpose of the paper to outline the medical and administrative organization which has matured as the scope of this form of therapy enlarged. The problems emerging as the service grew have included those of teaching of medical students, nurses' training, social service, home care of the patients and many others, in addition to such usual issues as indications for treatment, technic, complications and results.

The medical and administrative problems of out-patient electroshock therapy have been outlined. Many thousands of treatments have been administered on an ambulatory basis with results comparable to those obtained in hospitalized patients, while at the same time satisfying special needs and resolving special tissues. Methods, indications, complications, precautions and advantages have been discussed.

PRELIMINARY PROGRAM

TWENTY-FIFTH ANNUAL SCIENTIFIC SESSION
AND
INSTRUCTION COURSE

American Congress of Physical Medicine

September 2, 3, 4, 5, 6, 1947

HOTEL RADISSON, MINNEAPOLIS, MINN.

SCHEDULE OF INSTRUCTION SEMINAR

TUESDAY, SEPTEMBER 2

10:00 to 10:50—(1) **Peripheral Nerve Lesions (Physiologic Studies).** JUNG. Admiral Room

10:00 to 10:50—(2) **Peripheral Nerve Injuries (Physical Treatment and Splinting).** PRUCE. Grand Ballroom

11:00 to 11:50—(3) **Anatomical Reasons for Foot Strain (Treatment).** FRANCES BAKER. Admiral Room

11:00 to 11:50—(4) **Pain (Types: Neuritic, Referred, Causalgic and Ischemic).** HARPUDER. Grand Ballroom

3:00 to 3:50—(5) **Physics of and Physiologic Basis for the Use of Heat.** PAUL Admiral Room

3:00 to 3:50—(6) **Anatomical and Mechanical Factors in Pain Related to the Cervical and Thoracic Spine.** JESSIE WRIGHT. Grand Ballroom

4:00 to 4:50—(7) **Functional Anatomy of Hip Joint.** QUIRING. Admiral Room

4:00 to 4:50—(8) **Functional Anatomy of the Hand.** FRACKELTON. Grand Ballroom

WEDNESDAY, SEPTEMBER 3

8:30 to 9:20—(9) **Physiologic Basis for Therapeutic Exercise.** FISCHER. Admiral Room

8:30 to 9:20—(10) **Fundamentals of Electricity as Applied to Physical Medicine.** LION. Grand Ballroom

9:30 to 10:20—(11) **Reconditioning in Certain Medical and Surgical Conditions (Cardiac, Chest Surgery).** HUDDLESTON. Admiral Room

9:30 to 10:20—(12) **Rehabilitation of the Severely Disabled.** L. NEWMAN. Grand Ballroom

THURSDAY SEPTEMBER 4

8:30 to 9:20—(13) **Essentials of Muscle Reeducation. BENNETT.** Admiral Room

8:30 to 9:20—(14) **Lecture or Demonstration (Crutch Walking).** DEAVER. Grand Ballroom

9:30 to 10:20—(15) **Rehabilitation of the Industrially Injured.** MOLANDER. Admiral Room

9:30 to 10:20—(16) **Tests and Measurements (Joints, Strength Tests).** ELLEN DUVALL. Grand Ballroom

FRIDAY, SEPTEMBER 5

8:30 to 9:20—(17) **Electrical Stimulation of Denervated Muscle (With Actual Demonstration on a Model).** OSBORNE. Admiral Room

8:30 to 9:20—(18) **Use of Physical Therapy Following Various Fractures of the Extremities.** KNAPP. Grand Ballroom

9:30 to 10:20—(19) **Prescription Writing in Physical Medicine.** MARTIN. Admiral Room

9:30 to 10:20—(20) **Hydrotherapy.** McCLELLAN. Grand Ballroom

LECTURERS FOR INSTRUCTION SEMINAR

FRANCES BAKER, M.D., Assistant Clinical Professor, Orthopedic Surgery, University of California Medical School; Director, Department of Physical Medicine, University of California Hospital, San Francisco;

ROBERT L. BENNETT, M.D., Professor of Physical Medicine, Emory University Medical School; Director of Physical Medicine, Warm Springs Foundation, Warm Springs, Ga.;

GEORGE G. DEAVER, M.D., Physician in Charge of Rehabilitation and Physical Medicine, New York University Medical College and Bellevue Hospital, New York, N. Y.;

ELLEN NEALL DUVALL, Ph.D. (by invitation), Research Associate, Division of Clinical Research, Baruch Center of Physical Medicine, Medical College of Virginia, Richmond, Va.;

ERNST FISCHER, M.D., Professor of Physiology, Baruch Center of Physical Medicine, Medical College of Virginia, Richmond, Va.;

WILLIAM HAMILTON FRACKELTON, M.D., F.A.C.S. (by invitation), Department of Surgery and Anatomy, Marquette University School of Medicine; One Time Chief of Plastic-Hand Section, William Beaumont General Hospital, El Paso, Texas; Milwaukee, Wis.;

KARL HARPUDER, M.D., Assistant Clinical Professor of Medicine, Columbia University; Senior Consultant, Veterans Hospital, Bronx, New York, N. Y.;

O. LEONARD HUDDLESTON, M.D., Ph.D., Associate Professor of Medicine and Director Department of Physical Medicine, University of Southern California School of Medicine, Los Angeles;

FREDERICK T. JUNG, M.D. (by invitation), Assistant to the Secretary, Council on Pharmacy and Chemistry, American Medical Association, Chicago, Ill.;

MILAND E. KNAPP, M.D., Clinical Assistant Professor of Radiology and Director, Department of Physical Medicine, University of Minnesota, School of Medicine, Minneapolis;

KURT S. LION, M.D. Eng. (by invitation), Associate Professor of Applied Biophysics, Massachusetts Institute of Technology, Cambridge, Mass.;

GORDON M. MARTIN, M.D., Section on Physical Medicine, Mayo Clinic, Rochester, Minn.

WALTER S. McCLELLAN, M.D., Associate Professor of Medicine, Albany Medical College; Medical Director, The Saratoga Spa, Saratoga Springs, N. Y.;

CHARLES O. MOLANDER, M.D., Associate in Physical Medicine, Northwestern University Medical School; Director of Physical Medicine, Michael Reese Hospital, Chicago, Ill.;

LOUIS B. NEWMAN, M.E., M.D., Department of Physical Medicine, Northwestern University Medical School; Chief, Medical Rehabilitation Service, Veterans Administration, Hines, Ill.;

STAFFORD L. OSBORNE, Ph.D., Associate Professor of Physical Medicine, Northwestern University Medical School, Chicago, Ill.;

WILLIAM D. PAUL, M.D., Associate Professor of Medicine and Head of Division of Physical Medicine, State University of Iowa, Iowa City, Ia.;

ARTHUR M. PRUCE, M.D., Instructor, Department of Physical Medicine, Emory University Medical School; Attending Physician, Physical Medicine, Lawson Veterans Hospital, Atlanta, Ga.;

DANIEL P. QUIRING, Ph.D. (by invitation), Associate Professor of Biology, Western Reserve University; Head, Division of Anatomy, Cleveland Clinic, Cleveland, O.;

JESSIE WRIGHT, M.D., Director, D. T. Watson School of Physical Therapy, Affiliated with the University of Pittsburgh School of Medicine, Pittsburgh, Pa.

GENERAL INFORMATION

RULES GOVERNING THE READING OF PAPERS

No paper or address before the Congress shall occupy more than fifteen minutes in its delivery. The program is so arranged that all the time is utilized and it is therefore imperative that the stated time schedule is closely followed.

All papers read before the Congress shall be the property of the Congress for publication in the official journal. Each

paper shall be deposited with the secretary of the section when read.

THE CONVENTION

The registration desk will be open at 2 p. m., Monday, September 1 for preconvention registration. It is important that everyone register before entering the lecture hall. Those not wearing the official badge will be refused admission. This meeting is not open to the public. No registration fee will be charged.

BUSINESS SESSIONS

The annual business meetings for the members of the Congress will be held Tuesday, September 2, at 8:00 p. m. in the Grand Ballroom, and on Wednesday, September 3, at 5 p. m., in the Grand Ballroom.

CONGRESS DINNER

The annual Congress dinner will be held on Thursday evening, September 4 at 7 p. m. in the Grand Ballroom and dress is otional. Exhibitors and guests are welcome. An interesting but brief after-dinner program has been arranged. You will enjoy this occasion the only social function of the convention.

THE INSTRUCTION COURSE

The instruction course will be given from 10:00 to 10:50 and 11:00 to 11:50, Tuesday morning, September 2; from 3:00 to 3:50 and 4:00 to 4:50 p. m., Tuesday afternoon, September 2. It will continue at 8:30 to 9:20, and 9:30 to 10:20 the mornings of Wednesday, September 3, Thursday, September 4 and Friday, September 5. This schedule will enable attendance at both the course and scientific sessions.

Each registrant for the course is allowed the choice of one lecture during a period. Ten lectures may be selected from the twenty that are listed. The charge for the complete schedule of ten lectures is $15.00. Less than ten lectures may be scheduled at $2.00 per lecture. The right is reserved to reject any application if the Course Committee finds it desirable to do so. Registration for specific courses cannot be guaranteed when quotas are filled.

Those who have not completed their registration for the course should do so before attending any of the lectures. No one will be admitted to any of the course lectures without the official registration card for the course. Registration for the course may be completed on Monday, September 1, starting at 2:00 p. m., and continuing throughout the week at the main registration desk of the Congress.

SOCIETY OF PHYSICAL MEDICINE

The Society of Physical Medicine will hold its annual meeting, noon, luncheon, Wednesday, September 3, 12:30.

EDUCATIONAL CONFERENCES

An entire day has been set aside for the educational conferences. Tuesday, September 2, opening at 10:00 a. m., there will be a conference for physicians; at 12:00 noon, the consultants to the Council on Physical Medicine will meet and at 2 p. m., Tuesday, September 2, the conference will be thrown open for physicians and their technical directors.

SCIENTIFIC EXHIBITS

Scientific exhibits will be on display again and should prove of great interest. As was the custom formerly, medals will be awarded to those exhibits which are adjudged the outstanding ones by the committee on scientific awards and will be announced at the annual congress dinner, Thursday, September 4.

TECHNICAL EXHIBITS

The program of the scientific sessions and instruction course has been arranged with intermission periods to give time for visits and inspection of the technical exhibits. As these exhibits have been arranged with considerable effort we urge every member and guest to set aside sufficient time for a complete tour of all exhibits. Exhibits will be open from 9:00 a. m. to 6:00 p. m.

APPLICATION FOR INSTRUCTION COURSE

In Conjunction with the

Twenty-Fifth Annual Scientific and Clinical Session

of the

AMERICAN CONGRESS OF PHYSICAL MEDICINE

September 2, 3, 4, 5, 1947

Hotel Radisson, Minneapolis, Minn.

Name .....
(Please print)

Address .....

(If physician, please answer)

Member of A.M.A.....Member County Medical Society

.....Give name .....

Staff Government Service.....(give briefly, particulars

.....).

(If registered technician, please answer)
Only members of the American Registry of Physical Therapy Technicians are eligible to attend the course. Give Certificate Serial Number.....

Make up schedule in space below, listing courses by hour, day and number if possible (watch, please, do not duplicate):

.....
Signature in ink.

Date.....

Please make check payable to and mail it with your application to

American Congress of Physical Medicine

30 North Michigan Avenue Chicago 2, Illinois

GENERAL SCIENTIFIC SESSION

WEDNESDAY, September 3 — 10:30 A. M.

Spanish Room

OFFICERS OF THE SECTION

Chairman — WALTER M. SOLOMON, Cleveland.
Secretary — FRANCES BAKER, San Francisco.

Regulation of Blood Flow in the Human Muscle.
KARL HARPUDER, M.D., Assistant Clinical Professor of Medicine, Columbia University; Senior Consultant, Veterans Hospital, Bronx, New York.

The Effects of Artificial Fever on the Circulation in Man.
KHALIL G. WAKIM, M.D., Ph.D. (by invitation), Professor of Physiology and Research Consultant to the Section on Physical Medicine, Mayo Foundation, Rochester, Minnesota.

New Devices for Upper Extremity Disability Evaluation.
HELEN V. SKOWLUND, M.S. (by invitation), Research Associate, Division of Clinical Research, Baruch Center of Physical Medicine, Medical College of Virginia, Richmond;
F. A. HELLEBRANDT, M.D., Professor, Physical Medicine and Acting Director, Baruch Center Physical Medicine, Medical College of Virginia, Richmond,
and
LESLIE E. A. KELSO, B.S. (by invitation), Assistant Professor, Department Electrical Engineering, University of Wisconsin, Madison.

The Use of the Stewart Calorimeter in Physical Medicine.
SOPHIA ERNST, B.S. (by invitation), Department of Physiology, University of Minnesota School of Medicine, Minneapolis;
G. K. STILLWELL, B.A., M.D. (by invitation), Baruch Research Fellow in Physical Medicine, University of Minnesota School of Medicine, Minneapolis,
and
ALLAN HEMINGWAY, Ph.D. (by invitation), Associate Professor of Physiology, University of Minnesota School of Medicine, Minneapolis.

Conduction Velocity of the Skeleto-Motor Nerve Fibers Supplying Paretic Muscles.
ROBERT HODES, Ph.D. (by invitation), Assistant Professor of Physical Medicine, Graduate School of Medicine, University of Pennsylvania, Philadelphia.

Electromyeography in Kinesiologic Evalution.
LEONARD J. YAMSHON, M.D., Department of Physical Medicine, Mt. Sinai Hospital, New York, N. Y.,
and
WILLIAM BIERMAN, M.D., Department of Physical Medicine, Mt. Sinai Hospital, New York, N. Y.

GENERAL SCIENTIFIC SESSION

WEDNESDAY, September 3 — 10:30 A. M.

Grand Ballroom

OFFICERS OF THE SECTION

Chairman — WILLIAM BIERMAN, New York, N. Y.
Secretary — DONALD L. ROSE, Kansas City, Kans.

Advertising in Physical Medicine.
HOWARD A. CARTER, M.E., Secretary, Council on Physical Medicine, American Medical Association, Chicago.

Space and Personnel Requirements Necessary to Establish a Physical Medicine and Medical Rehabilitation Service in Hospitals of Various Sizes.
DONALD A. COVALT, M.D., Assistant Medical Director, Medical Rehabilitation, Veterans Administration, Washington, D. C.

Dynamic Aspects of Physical Medicine in the Veterans Administration.
A. B. C. KNUDSON, M.D., Assistant Chief, Physical Medicine Division, Medical Rehabilitation Service, Department of Medicine and Surgery, Veterans Administration, Washington, D. C.

Serratus Magnus Paralysis.
KRISTIAN G. HANSSON, M.D., Assistant Professor in Orthopedics, Cornell University School of Medicine and Director of the Departments of Physical Medicine, New York Hospital and Hospital for Special Surgery, New York, N. Y.

Common Shoulder Lesions, Their Diagnosis and Treatment.
BROR S. TROEDSSON, A.B., M.D., Physiatrist, Department of Physical Medicine, Orange Memorial Hospital; Consultant in Physical Medicine, New Jersey Orthopedic Hospital, Orange, New Jersey.

Evaluation of Training of Physical Educationists for Reconditioning and Rehabilitation.
H. HARRISON CLARKE, M.S., Ed.D., Professor of Physical Education and Director of Graduate Study, Springfield College, Springfield, Mass.
and
EARL C. ELKINS, M.D., Section on Physical Medicine, Mayo Clinic, Rochester, Minn.

GENERAL SCIENTIFIC SESSION

WEDNESDAY, September 3 — 2:00 P. M.

Grand Ballroom

OFFICERS OF THE SECTION

Chairman — WILLIAM SCHMIDT, Philadelphia.
Secretary — DONALD ERICKSON, Minneapolis.

Corrective Physical Rehabilitation for Neuropsychiatric Patients.
JOHN EISELE DAVIS, Sc.D. (by invitation), Chief, Corrective Physical Rehabilitation, Veterans Administration, Washington, D. C.

Physical Medicine an Adjunct in the Management of Chronic Osteomyelitis.
MAJOR JOHN H. KUITERT, M.C., Chief, Physical Medicine Service, Fitzsimons General Hospital, Denver.

The Coordination of Physical and Occupational Therapy in the Physical Rehabilitation Program of a General Hospital.
MAX K. NEWMAN, M.D., Chief of Section, Physical Medicine and Rehabilitation, Grace Hospital; Head of Section, Physical Medicine, Wayne University, Detroit,
and
HARRIET BARBARA JEWETT, O.T.R. (by invitation), Director of Occupational Therapy Course, Wayne University; Director of Occupational Therapy Department, Grace Hospital, Detroit.

Back Manipulations — When Indicated.
FREDERICK A. JOSTES, M.D. (by invitation), Assistant Professor of Clinical Orthopedic Surgery, Washington University School of Medicine, St. Louis.

Further Studies in Low Backache With Persistent Muscle Spasm.
MARGARET H. CLARE, B.S. (by invitation), Research Worker in Department of Physical Therapy, Barnes Hospital and Department of Neurophysiology, Washington University School of Medicine, St. Louis;
GEORGE BISHOP, M.D. (by invitation), Professor of Neurophysiology, Washington University School of Medicine, St. Louis,
and
FRANK H. EWERHARDT, M.D., Assistant Professor of Physical Medicine, Washington University School of Medicine, St. Louis.

Rehabilitation in a General Hospital.
GEORGE G. DEAVER, M.D., Physician in Charge of Physical Medicine and Rehabilitation, New York University College of Medicine and Bellevue Hospital, New York, N. Y.

GENERAL SCIENTIFIC SESSION

WEDNESDAY, September 3 — 8:00 P. M.

OFFICERS OF THE SECTION

Chairman — WALTER S. MCCLELLAN, Saratoga Springs, N. Y.
Secretary — RICHARD KOVACS, New York, N. Y.

FORMAL OPENING OF THE 25TH ANNUAL SESSION

INVOCATION

Rev. Frederick Tyner

ADDRESSES OF WELCOME

L. R. Boies, M.D.
President, Hennepin County Medical Society
John M. Culligan, M.D.
President, Ramsey County Medical Society
Louis A. Buie, M.D.
President, Minnesota State Medical Association

INDUCTION OF PRESIDENT-ELECT
ADDRESS

The Physiatrist.
H. WORLEY KENDELL, M.D., Chicago.

Research in Medicine.
A. C. Ivy, Ph.D., M.D., Distinguished Professor of Physiology in the Graduate School; Vice-President in Charge of the Chicago Professional Colleges, University of Illinois, Chicago.

Research in Industry.
C. F. KETTERING, Director of Research, General Motors, Detroit.

GENERAL SCIENTIFIC SESSION

THURSDAY, September 4 — 10:30 A. M.

Grand Ballroom

OFFICERS OF THE SECTION

Chairman — FRANK H. EWERHARDT, St. Louis.
Secretary — MADGE C. L. MCGUINNESS, New York, N. Y.

Early Ambulation and Related Procedures in Surgery.
D. J. LEITHAUSER, M.D., F.A.C.S. (by invitation), Chief of Surgery, St. Joseph Mercy Hospital, Detroit.

Early Ambulation in Surgical Convalescence.
NATHANIEL GLICKMAN, M.S. (by invitation), Department of Medicine, University of Illinois College of Medicine, Chicago;
ROBERT W. KEETON, M.D. (by invitation), Professor of Medicine and Head of Department, University of Illinois College of Medicine, Chicago;
WARREN H. COLE, M.D. (by invitation), Professor of Surgery and Head of Department, University of Illinois College of Medicine, Chicago;
NATHANIEL O. CALLOWAY, M.D. (by invitation), Department of Medicine, University of Illinois College of Medicine, Chicago;
H. H. MITCHELL, Ph.D. (by invitation), Professor, Department Animal Nutrition, University of Illinois, Urbana,
and
ANTHONY SAPIENZA, M.D. (by invitation), Department of Medicine, University of Illinois College of Medicine, Chicago.

Physical Medicine and Rehabilitation in a Tuberculosis Hospital.
MORRIS RUBINSTEIN, M.D., Chief, Physical Medicine, Veterans Administration, Livermore, Cal.

Physical Exercise in the Rehabilitation of Tuberculous Patients.
EDWIN R. LEVINE, M.D. (by invitation), Director of Chest Service, Michael Reese Hospital; Medical Director, Winfield Hospital, Chicago;
CHARLES O. MOLANDER, M.D., Director, Department of Physical Medicine, Michael Reese Hospital, Chicago,
and
JEANNE HOEL ABNETT, B.A. (by invitation), Winfield Hospital, Chicago.

Effects of Therapeutic Exercise on the Circulation of the Paralytic.
EARL C. ELKINS, M.D., Section on Physical Medicine, Mayo Clinic, Rochester, Minn.;
HOWARD F. POLLEY, M.D., Section on Physical Medicine, Mayo Clinic, Rochester, Minn.,
and
KHALIL G. WAKIM, M.D., Ph.D. (by invitation), Professor of Physiology and Research Consultant to the Section on Physical Medicine, Mayo Foundation, Rochester, Minn.

GENERAL SCIENTIFIC SESSION

THURSDAY, September 4 — 10:30 A. M.

Spanish Room

OFFICERS OF THE SECTION

Chairman — NATHAN H. POLMER, New Orleans.
Secretary — BENJAMIN A. STRICKLAND, JR., Washington, D. C.

Studies on Biological Responses to Thermogenic Agents.
WILLIAM D. PAUL, M.D., Assistant Professor of Medicine, Director, Department Physical Medicine, State University of Iowa School of Medicine, Iowa City;
HARRY M. HINES, Ph.D. (by invitation), Professor and Head, Department of Physiology, State University of Iowa School of Medicine, Iowa City;
C. R. KEMP, Ph.D. (by invitation), Research Assistant, Department of Physical Medicine, State University of Iowa School of Medicine, Iowa City,
and
ALFRED W. RICHARDSON, M.A. (by invitation), Research Assistant, Department of Physiology, State University of Iowa School of Medicine, Iowa City.

Educational Research in Physical Therapy: I. Teaching Technical Skills by the Laboratory Method.
ELLEN NEALL DUVAL, Ph.D. (by invitation), Research Associate, Division of Clinical Research, Baruch Center of Physical Medicine, Medical College of Virginia, Richmond,
and
F. A. HELLEBRANDT, M.D., Professor, Physical Medicine and Acting Director, Baruch Center of Physical Medicine, Medical College of Virginia, Richmond.

Electrical Measurements of Pain Tolerance.
SEDGWICK MEAD, M.D., Baruch Fellow in Physical Medicine, Harvard Medical School; Clinical Fellow in Physical Medicine, Massachusetts General Hospital, Littleton, Mass.,
and
DONALD L. ROSE, M.D., formerly Baruch Fellow in Physical Medicine, Harvard Medical School; Director, Physical Medicine, University of Kansas School of Medicine, Kansas City, Kans.

An Analysis of Some of the Forces Exerted in the Human Gait.
IRVING REHMAN, Ph.D., Assistant Professor of Anatomy and Physical Medicine, University of Southern California School of Medicine, Los Angeles,
and
PAUL R. PATEK, Ph.D. (by invitation), Professor of Anatomy and Head of the Department, University of Southern California School of Medicine, Los Angeles.

The Influence of Hot and Cold Baths on the Cardiovascular System.
STEVEN M. HORVATH, M.S., Ph.D. (by invitation), Assistant Professor of Physical Medicine, Graduate School of Medicine, University of Pennsylvania, Philadelphia.

GENERAL SCIENTIFIC SESSION

THURSDAY, September 4 — 2:00 P. M.

Grand Ballroom

OFFICERS OF THE SECTION

Chairman — FRED B. MOOR, Los Angeles.
Secretary — ARTHUR E. WHITE, Battle Creek.

Manipulation of the Joints of the Upper Extremity.

JAMES MENNELL, M.A., M.D. (by invitation), Consulting Physiotherapist, St. Thomas' Hospital, London.

Misuses and Pitfalls in Physical Medicine.

RICHARD KOVACS, M.D., Professor of Physical Medicine, New York Polyclinic Medical School and Hospital, New York, N. Y.

The Use of Physical Therapy in the Postoperative Management of Tendon Transfers and Grafts in the Hand.

GEORGE PHALEN, M.D. (by invitation), Orthopaedic Department, Cleveland Clinic, Cleveland.

Physical Mechanism and Energy Distribution in Diathermy with Radar (Micro-) Waves.

KURT S. LION, D. Eng. (by invitation), Associate Professor of Applied Biophysics, Massachusetts Institute of Technology, Cambridge, Mass.

Preliminary Report of Experimental Observations on the Heating Effect of Microwaves "Radar" in Living Tissues.

URSULA LEDEN, M.D. (by invitation), Fellow in Physical Medicine, Mayo Clinic, Rochester, Minn.;

JULIA F. HERRICK, B.A., M.A., Ph.D. (by invitation), Associate Professor of Experimental Medicine, Institute of Experimental Medicine, Mayo Foundation, Rochester, Minn.;

KHALIL G. WAKIM, M.D., Ph.D. (by invitation), Professor of Physiology and Research Consultant to the Section on Physical Medicine, Mayo Foundation, Rochester, Minn.,

and

FRANK H. KRUSEN, M.D., Professor of Physical Medicine, Mayo Foundation, University of Minnesota; Head of the Section on Physical Medicine, Mayo Clinic, Rochester, Minn.

ANNUAL CONGRESS DINNER

THURSDAY, September 4 — 7:00 P. M.

TOASTMASTER: H. WORLEY KENDELL, M.D.
President

GUEST SPEAKERS

GEORGE F. LULL, M.D.
Secretary and General Manager
American Medical Association

PAUL MAGNUSON, M.D.
Department of Medicine and Surgery
Veterans Administration

AWARDS

FRANK H. EWERHARDT, M.D.
Chairman, Awards Committee

GENERAL SCIENTIFIC SESSION

FRIDAY, September 5 — 10:30 A. M.

Spanish Room

OFFICERS OF THE SECTION

Chairman — WILLIAM D. PAUL, Iowa City.
Secretary — ISADORE LEVIN, Washington, D. C.

Round Table Discussion on Biophysics.

Moderator, *Frank H. Krusen*, M.D., Professor of Physical Medicine, Mayo Foundation, University of Minnesota; Head of Section on Physical Medicine, Mayo Clinic, Rochester, Minn.;

HOWARD A. CARTER, M.E., Secretary, Council on Physical Medicine, American Medical Association, Chicago;

JULIA F. HERRICK, B.A., M.A., Ph.D. (by invitation), Associate Professor of Experimental Medicine, Institute of Experimental Medicine, Mayo Foundation, Rochester, Minn.;

KURT S. LION, D. Eng. (by invitation), Associate Professor of Applied Biophysics, Massachusetts Institute of Technology, Cambridge, Mass.;

FRANCIS O. SCHMITT, Ph.D. (by invitation), Head of Department of Biology, Massachusetts Institute of Technology, Cambridge, Mass.,

and

MARVIN M. D. WILLIAMS, Ph.D. (by invitation), Department of Biophysics, Mayo Clinic, Rochester, Minn.

Physical Physiology as a Basis for Physical Medicine.

FREDERIC T. JUNG, Ph.D., M.D. (by invitation), Assistant to the Secretary of the Council on Pharmacy and Chemistry, American Medical Association, Chicago.

The Clinical Application of Physics and Physiology in Physical Medicine.

COL. ARTHUR E. WHITE, M.C., Chief of Physical Medicine Service, Percy Jones General Hospital, Battle Creek.

Physical Medicine in Industrial and Insurance Practice.

CARL M. PETERSON, M.D. (by invitation), Secretary, Council on Industrial Health of the American Medical Association, Chicago.

GENERAL SCIENTIFIC SESSION

FRIDAY, September 5 — 10:30 A. M.

Grand Ballroom

OFFICERS OF THE SECTION

Chairman — EUCLID SMITH, Hot Springs, Ark.
Secretary — NILA K. COVALT, Washington, D. C.

Physical Medicine and Rehabilitation in a County Home.

MURRAY B. FERDERBER, M.D., Department of Medicine, University of Pittsburgh School of Medicine; Director, Department of Physical Medicine, Presbyterian Hospital; Consultant in Physical Medicine and Rehabilitation, Allegheny County Institution District, Pittsburgh,

and

GERALD P. HAMMILL, M.D. (by invitation), Director of the Alleghency County Institution District, Pittsburgh.

Oximetry in Poliomyelitis.

GLENN GULLICKSON, JR., B.A., M.D. (by invitation), Fellow in Physical Medicine, University of Minnesota School of Medicine, Minneapolis;

JAMES O. ELAM, M.D. (by invitation), Research Fellow, Department of Physiology, University of Minnesota School of Medicine, Minneapolis,

and

ALLAN HEMINGWAY, Ph.D. (by invitation), Associate Professor of Physiology, University of Minnesota School of Medicine, Minneapolis.

Low Grade Fever Therapy in the Treatment of Rheumatoid Arthritis.
GLENN E. DREWYER, M.D., F.A.C.P., Internist, Glenwood Springs, Colo.

Anatomical and Physiologic Analysis of Reconditioning Procedures.
LT. COL. B. A. STRICKLAND, JR., M.C., Chief, Physical Medicine Consultants Division, Office of The Surgeon General, Washington, D. C.;
CECIL W. MORGAN, B.S., M.Ed., Ph.D. (by invitation), Chief of the Physical Reconditioning Branch, Physical Medicine Consultants Division, Office of The Surgeon General, Washington, D. C.,
and
IRA R. TELFORD, A.B., A.M., Ph.D. (by invitation), Executive Officer and Assistant Professor in Anatomy, George Washington University School of Medicine, Washington, D. C.

Physical Medicine for Paraplegias and Amputees in Veterans Administration Hospitals.
JOHN H. ALDES, M.D., Chief, Orthopedic Surgery, Physical Medicine and Medical Rehabilitation, Birmingham Veterans Administration Hospital, Van Nuys, Cal.

The American Legion Rehabilitation and Physical Medicine Program for Veterans.
JOSEPH E. MALCOMSON, M.D., Medical Consultant, National Rehabilitation Committee, The American Legion, Washington, D. C.

GENERAL SCIENTIFIC SESSION

FRIDAY, September 5 — 2:00 P. M.

Grand Ballroom

OFFICERS OF THE SECTION

Chairman — ROBERT L. BENNETT, Warm Springs, Ga.
Secretary — CHARLES O. MOLANDER, Chicago.

A Challenge to Physical Medicine.
HART E. VAN RIPER, M.D. (by invitation), Medical Director, National Foundation for Infantile Paralysis, New York, N. Y.

Symposium on Poliomyelitis.

Physiology of Respiration as Applied to the Treatment of Bulbar Poliomyelitis.
WILLIAM KUBICEK, Ph.D. (by invitation), Assistant Professor in Physiology, University of Minnesota School of Medicine, Minneapolis;

Results of Tracheotomy in Bulbar Poliomyelitis.
ROBERT E. PRIEST, M.D. (by invitation), Chief of Otolaryngology, Minneapolis General Hospital, Minneapolis.

Effects of Anoxia on the Brain Stem.
ERNST GELLHORN, M.D. (by invitation), Department of Physiology, University of Minnesota School of Medicine, Minneapolis.

Pathology of Changes in Bulbar Poliomyelitis.
A. B. BAKER, M.D. (by invitation), Director of Neurology, University of Minnesota School of Medicine, Minneapolis.

Treatment of the Muscular After-Affects of Poliomyelitis.
MILAND E. KNAPP, M.D., Clinical Assistant Professor of Radiology, and Director, Department of Physical Medicine, University of Minnesota School of Medicine, Minneapolis.

Evaluation of Aids to Muscle Reeducation in the Treatment of Poliomyelitis.
FREDERIC J. KOTTKE, M.D. (by invitation), Baruch Fellow in Physical Medicine, University of Minnesota School of Medicine, Minneapolis;
BARBRO TEIGEN, B.A. (by invitation), University of Minnesota School of Medicine, Minneapolis;
SHELDON C. SIEGEL, M.D. (by invitation), Department of Pediatrics, University of Minnesota School of Medicine, Minneapolis,
and
MILAND E. KNAPP, M.D., Clinical Assistant Professor of Radiology, and Director, Department of Physical Medicine, University of Minnesota School of Medicine, Minneapolis.

Electromyographic Studies of Paralyzed and Paretic Muscles in Anterior Poliomyelitis.
O. LEONARD HUDDLESTON, M.D., Ph.D., Assistant Professor of Medicine; Director, Department of Physical Medicine, University of Southern California, Los Angeles,
and
JAMES G. GOLSETH, M.D., Assistant Professor of Physical Medicine, University of Southern California, Los Angeles.

GENERAL SCIENTIFIC SESSION

SATURDAY, September 6 — 9:00 A. M.

Spanish Room

OFFICERS OF THE SECTION

Chairman — ARTHUR L. WATKINS, Boston, Mass.
Secretary — DONALD A. COVALT, Washington, D. C.

A Study of Frostbite in Normal, Heparinized and Thrombocytopenic Rats.
MARJORIE B. ZUCKER, M.D. (by invitation), Research Assistant, Department of Physiology, Baruch Committee on Physical Medicine, Columbia University College of Physicians and Surgeons, New York, N. Y.

Some Factors Regulating the Composition and Formation of Human Sweat.
ROBERT C. DARLING, M.D. (by invitation), Associate Professor of Medicine, Department of Medicine, College of Physicians and Surgeons, Columbia University, New York, N. Y.

Thermal Gradients During Varying Body Temperatures.
LUDWIG W. EICHNA, M.D. (by invitation), Associate Professor of Medicine, New York University College of Medicine, New York, N. Y.

Some Enzyme Activities of Denervated Muscle.
ERNST FISCHER, M.D., Professor of Physiology, Baruch Center of Physical Medicine, Medical College of Virginia, Richmond.

Electrical Stimulation of Motor Points in Normal Subjects.
MERYL MILES, M.S. (by invitation), Department of Anatomy, University of Wisconsin, Madison.

The Measurement of Surface Temperatures.
G. K. STILLWELL, B.A., M.D. (by invitation), Baruch Research Fellow in Physical Medicine, University of Minnesota School of Medicine, Minneapolis,
and
ALLAN HEMINGWAY, Ph.D. (by invitation), Associate Professor of Physiology, University of Minnesota School of Medicine, Minneapolis.

The Effect of Diathermy on Blood Flow; Plethysmographic Studies.
CHARLES S. WISE, M.D., Baruch Fellow in Physical Medicine, Harvard Medical School; Clinical Fellow in Physical Medicine, Massachusetts General Hospital, Cambridge, Mass.

SCIENTIFIC EXHIBITS

See Final Program
for announcement
of exhibitors
and description
of exhibits.

TECHNICAL EXHIBITS

AMERICAN HOSPITAL SUPPLY CORPORATION.

The new Vasoscillator, recently in public print, is a scientifically designed oscillating bed for the treatment of peripheral vascular diseases. Treatment is simple, automatic, uninterrupted. It eliminates the need for manual exercise. It redevelops muscle tone in capillaries and veins, relieves venous stasis, and aids in preventing hypostatic congestion.

ARCHIVES OF PHYSICAL MEDICINE.

The leading publication in the field of physical medicine, issued monthly by the American Congress of Physical Medicine.

AUDIO DEVELOPMENT COMPANY.

Audio Development Company has maintained a consistent leadership in research and development to provide the medical profession with a new and more accurate, convenient and dependable method for determining hearing acuity.

ADC AUDIOMETERS provide pure test tones.
Reveal hearing loss direct in decibles.
And are equipped with double headsets.

THE BIRTCHER CORPORATION.

THE BURDICK CORPORATION.

The Burdick Corporation will exhibit their complete line of electro-therapeutic equipment. This will include Infra-Red and Ultraviolet Lamps, Short Wave Diathermy, Galvanic and Stimulating Current Apparatus and the Rhythmic Constrictor for the treatment of peripheral vascular conditions.

THE COCA-COLA COMPANY.

Coca-Cola will be served through the courtesy of the Coca-Cola Company.

THE DIERKER COMPANY — MANUFACTURERS.

Dierker Therapeutic Apparatus for administering treatment and medication to accessible cavities; reprints of scientific papers by eminent clinicians who are users of the Dierker Apparatus will be available on request, 6529 Santa Monica Blvd., Los Angeles 38, Calif.

E & J MANUFACTURING COMPANY.

The E & J Manufacturing Company will exhibit the latest development in the E & J Resuscitator Inhalator and Aspirator. You are cordially invited to witness interesting demonstrations of resuscitation by both mask and intratrachael catheter.

H. G. FISCHER & CO.

Visitors to the 25th Annual Session of the American Congress of Physical Medicine are cordially invited to visit our FISCHER Display and to inspect the new units of FISCHER apparatus to be shown. FISCHER apparatus is characterized by precision design and convenient, efficient operation. FISCHER representatives will be present to answer questions and to demonstrate outstanding features of FISCHER equipment.

GENERAL ELECTRIC X-RAY CORPORATION.

General Electric X-Ray Corporation presents their electromedical equipment incorporating recent changes and improvements designed to facilitate the therapeutic effectiveness of established apparatus.

Exhibit will include Inductotherm, Ultraviolet and Infra-Red, Hydrotherapy Bath, Galvanic and Sinusoidal Current Generators and the new Metal Locator.

HANOVIA CHEMICAL AND MANUFACTURING COMPANY.

Welcome to our exhibit! A complete line of ultraviolet quartz lamps, high-pressure type, for orificial and body irradiation will be on display. New black light for fluorescent diagnosis. New model Short Wave equipment and Safe-T-Aire lamps for destruction of air-borne bacteria. Courteous and competent representatives on hand to greet you.

ILLE ELECTRIC CORPORATION.

Hydromassage Subaqua Therapy Equipment.—Ille Electric Corporation will demonstrate how the care of infantile paralysis, arthritis and other disabling conditions can be greatly improved by the use of Hydromassage Subaqua Therapy Tanks. They will also display an improved Mobile Whirlpool Bath, Mobile Sitz Bath Chair, Improved Paraffin Bath, Folding Thermostatic Bed Tent and Hydrosteril Lamp.

PAUL E. JOHNSON, MFRS.

Paul E. Johnson, Mfrs., offer to the medical profession high quality, well built, efficient physical therapy equipment consisting of short wave diathermy units, galvanic, sinusoidal and faradic current units, ultraviolet lamps of the quartz and carbon arc types, localized as well as body types infra-red lamps and colonic irrigators.

THE LIEBEL-FLARSHEIM CO.

The Liebel-Flarsheim Company cordially invites you to stop at their booth for examination and demonstration of the Model SW-227 Frequency-Controlled Short-Wave Diathermy Unit. Capable representatives will be on hand at all times to answer your questions about our physical-therapy apparatus. The Portable Bovie Electrosurgical Units will also be on display.

R. J. LINDQUIST COMPANY.

Electrical Muscle Stimulation (including Electrodiagnosis and Chronaxia testing) and the latest technics of orificial ultra short wave therapy will be featured using the original CHRONOWAVE low voltage generator, the CHRONAXIMETER, DESERT-SUN Lamps and ULTRA SHORT WAVES, products of the R. J. Lindquist Co., of Los Angeles.

McINTOSH ELECTRICAL CORPORATION.

In our exhibit, sixty-eight years continuous experience serving physicians will be exemplified. The Hogan Brevatherm Model 8890 Short-Wave Diathermy apparatus with stabilized frequency, guaranteed to operate within the F.C.C. authorized channel will be shown. Also the well known McIntosh Polysine Generator, sinusoidal and galvanic apparatus, McIntosh Sinustat and Biolite, Infra-red Lamp will be shown. Courteous representatives will explain the special advantages of McIntosh equipment.

PHILIP MORRIS & COMPANY.

Philip Morris & Company will demonstrate the method by which it was found that Philip Morris Cigarettes, in which diethylene glycol is used as the hygroscopic agent, are less irritating than other cigarettes. Their representative will be happy to discuss researches on this subject, and problems on the physiological effects of smoking.

PHYSICIANS AND HOSPITALS SUPPLY CO.

You are cordially invited to visit our exhibit. We will welcome an opportunity to show you the many new and interesting items which we will have on display.

RAYTHEON MANUFACTURING COMPANY.

Microtherm.—A diathermy generator that provides ample penetrating heat for all localized treatments in the clinic or home. Special advantages of microwave diathermy (as compared with short wave diathermy) include high absorption in human tissue, superior heating of muscle and precision direction and control of energy. Easily applied; completely comfortable and safe.

REXAIR, INC.

Rexair is a portable air cleaner that performs many home and hospital jobs. It purifies, deodorizes and humidifies; the air; cleans floors, walls and furniture; scrubs floors; draws in dustladen air and sends out clean, moist air. Dirt is trapped in water, poured down the drain. There is no bag to empty.

THE RIES CORPORATION.

Rust proof equipment for administering moist heat to any part of the body. Comfort for the patient, safety and ease of operation are produced by simplicity of control. Where extensive hyperemia is desired, "Moistaire" is invaluable in the field of physical medicine and rehabilitation.

TECA CORPORATION.

Specializing in low-volt therapy equipment, we will exhibit latest models of galvanic and sinusoidal generators. Shown are, among other models, the new Low-Volt Generators CD6 and SP3; as well as HP4 delivering continuous currents in various forms. The TECA Bitrodes, bipolar electrodes for testing and local treatments will be demonstrated.

WORLD WIDE ELECTRONICS, INC.

We again have the pleasure of inviting you to visit our exhibit and view our latest Short Wave Diathermy Equipment, built to conform to F.C.C. proposed specifications, Low Volt Generators, Shock Therapy and Whirlpool Bath equipment.